Essays on Tax Avoidance, Monetary Policy and International Trade

Summer 8-29-2017

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ABSTRACT

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AUGUST 2017

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This dissertation consists of three distinct essays on tax avoidance, monetary policy and international trade.

The first chapter focuses on profit shifting. Multinational enterprises (MNEs) manipulate the prices that they use for intracompany transactions (known as transfer prices) to shift profits to countries with more favorable tax treatments. I improve upon the current practice to estimating this elasticity by constructing a measure of the stringency with which countries enforce their anti-tax avoidance rules and take into account their incentive to enforce them. I report evidence showing that the failure to account for the enforcement of anti-tax avoidance rules and the incentive to enforce them results not only in biased estimates of the semi-elasticity of reported profits with respect to CIT-rate but also results in a misspecified empirical model. I estimate the empirical model of reported profits using detailed annual data on more than 40,000 affiliates located in 28 countries during the period from 2008 to 2014.

The second chapter I conduct an event study to first examine the role of macroeconomic news surprises on monetary policy expectations; second, I estimate the effect that changes in short and long-term monetary policy expectations have on financial markets on days of macroeconomic news announcements compared to days of federal open market committee (FOMC) announcements. Factor analysis is used to build a short and a long-term measure of

monetary policy expectations using federal funds futures and Eurodollar futures. I conclude that the path and the target factors are both affected by several macroeconomic news surprises.

Finally in the last chapter I use a stochastic general equilibrium, two-country model of trade and macroeconomic dynamics developed by Ghironi & Melitz (2005) to assess the effect of two exogenous shocks: a negative technology shock to China's productivity and a trade policy shock that makes exporting to China less costly and importing from China more expensive (known as the border-adjustment tax). I find that a negative productivity shock in China results in a reduction of imports from China and an increase in the entry of firms in the United States. At the contrary, a trade policy shock in the United States leaves American (Chinese) consumers slightly worst (better) off.

ESSAYS ON TAX AVOIDANCE, MONETARY POLICY AND INTERNATIONAL TRADE

GIULIA ZILIO

A Dissertation Submitted in Partial Fulfillment of the Requirements for the Degree
of
Doctor of Philosophy
in the
Andrew Young School of Policy Studies
of
Georgia State University

GEORGIA STATE UNIVERSITY
2017

ACCEPTANCE

This dissertation was prepared under the direction of Giulia Zilio’s Dissertation Committee. It has been approved and accepted by all members of that committee, and it has been accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Economics in the Andrew Young School of Policy Studies of Georgia State University.

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August, 2017

DEDICATION

To my father Maurizio Zilio, my mother, Miranda Bullo, and my sister Chiara Zilio.

Acknowledgements

My deepest gratitude goes to the members of my committee, Dr. Sally Wallace, Dr. Federico Mandelman, Dr. Pierre Nguimkeu and Dr. Antonio Saravia, for their support and guidance throughout my research. They dedicated an enormous amount of time to supervise me both academically and personally. They encouraged me to try harder and gave me more confidence in my ability to pursue my research.

My sincere appreciation is extended to Dr. Mark Rider for his continual support and kindness. His door was always open, and he always had time to answer my questions, and provided help when needed. He has also given me valuable feedback to improve the quality of my dissertation. Even though he was not part of my dissertation committee, he was instrumental in bringing the dissertation to this point. He has been a mentor and a friend since the beginning of my Ph.D.

I have also benefited from a number of people who provided important comments and suggestions on this dissertation. I am thankful to Dr. John Gibson, Dr. Garth Heutel, Dr. Daniel Kreisman for their comments and suggestions. A special thanks is also extended to the Research Department at the Federal Reserve Bank of Atlanta for their support during the last years of my Ph.D. program. My gratitude also goes to participants in workshops, seminars and conferences in which I have presented my work. I am also grateful to the Department of Economics at Georgia State University, faculty and staff, for their kindness throughout my Ph.D. program. I am especially thankful to Dr. Grace O who helped me during my undergraduate studies and encouraged me to pursue a Ph.D. degree in Economics.

My heartfelt gratitude goes to my family, Maurizio Zilio, Miranda Bullo and Chiara Zilio, for their patience and moral support. Their unconditional love enabled me to complete this dissertation and pass the Ph.D. comprehensive exams. I would not be where I am today without their constant support.

Finally, I would like to thank my friends, especially those that have provided enormous help by reading my chapters, giving me feedback and helping enrich my ideas. My sincere gratitude goes to Ellyn Terry, Eric Napierala, Jennifer Landwehr ,Valeria Vargas and Elise Blankenship for the time they invested in revising my work and for their valuable friendship. They have stood by me through all these years, providing laughter and support. I am very lucky to have them as friends. Also, I would like to thank Matteo Battilana, Antonios Koumpias, Isabel Carro Toro and Florian Rundhammer for their valuable friendship and support.

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Introduction

My dissertation is divided in three different chapters: “Cross-Country Differences in Corporate Tax Rates, Anti-Tax Avoidance Rules, and Base Erosion Profit Shifting”, “Does Macroeconomic News Affect Monetary Policy Expectations and Asset Prices? Evidence from Event Studies” and “The Impact of China’s Economic Slowdown and United States’ New Trade Policy on both the United States and China”.

In the first chapter I look at how Cross-country differences in corporate income tax (CIT) rates create incentives for multinational enterprises (MNEs) to manipulate the prices that they use for intracompany transactions (known as transfer prices) to shift profits to countries with more favorable tax treatments. Such behavior reduces the aggregate tax burden of an MNE thus increasing its worldwide after-tax profits, which presumably increases stockholder value. However, this behavior also erodes the CIT bases of countries, like the United States and other OECD countries, with relatively high CIT rates. To mitigate such behavior, governments adopt and enforce anti-tax avoidance rules. In this paper, I seek to gauge the effect on profit shifting of CIT-rate differentials among countries. I improve upon the current practice to estimating this elasticity by constructing a measure of the stringency with which countries enforce their anti-tax avoidance rules and take into account their incentive to enforce them. I report evidence showing that the failure to account for the enforcement of anti-tax avoidance rules and the incentive to enforce them results not only in biased estimates of the semi-elasticity of reported profits with respect to CIT-rate but also results in a misspecified empirical model. I estimate the empirical model of reported profits using detailed annual data on more than 40,000 affiliates located in 28 countries during the period from 2008 to 2014. To illustrate the practical consequences for tax policy analysis of correctly specifying the empirical model, I conduct a policy simulation in which the United States reduces its CIT rate by 20 percent.

The second chaper focuses on monetary polices and central bank annuncements. Interest rates have played a crucial role in the latest global financial crisis. Financial investors closely follow macroeconomic news announcements in order to predict central banks' monetary policies, which indirectly affect interest rates. In this paper, I first examine the role of macroeconomic news surprises (specifically those related to the labor market, GDP, ISM, CPI, consumer confidence, retail sales and new home sales) on monetary policy expectations; second, I estimate the effect that changes in short and long-term monetary policy expectations have on financial markets on days of macroeconomic news announcements compared to days of federal open market committee (FOMC) announcements. Factor analysis is used to build a short- (target factor) and a long-term (path factor) measure of monetary policy expectations using federal funds futures and Eurodollar futures. Finally, after performing several event studies using United States financial data from 1998 to 2014, I conclude that the path and the target factors are both affected by several macroeconomic news surprises; investor's expectations of monetary policies are also impacted by positive and negative macroeconomic news announcements; financial markets' reactions to monetary policy expectations are larger in absolute value on days of numerous macroeconomic indicators announcements compared to days of FOMC announcements. Focusing on the latest financial crisis, I report evidence that investor's short-term monetary policy expectations are not affected by unexpected changes in macroeconomic indicators.

The last and third chapter looks at numerous international trade dynamics between China and the United States. In recent years, large emerging markets have accounted for the majority of the growth of global demand. China is the largest of these fast growing emerging economies and the second largest economy in the world. For nearly two decades, China has been on the list of top ten U.S. trading partners. It is by far the United States' largest source of imported goods as well as an increasingly important destination for U.S.-made products. Therefore, it is not surprising that financial markets and policy makers in the United States closely follow news related to China. In this paper, I use a stochastic general equilibrium, two-country model of trade and macroeconomic dynamics developed by Ghironi & Melitz (2005) to assess the effect of two exogenous shocks. First, a negative technology shock to China's productivity and second, a trade policy shock that makes exporting to China less costly and importing from China more expensive (known as the border-adjustment tax). In this model, an exogenous shock to aggregate productivity or to trade costs induces firms to enter and exit, thus altering the composition of businesses. This in turn effects wages and the price and type of goods available to consumers in each country. I find that a negative productivity shock in China results in a reduction of imports from China and an increase in the entry of firms in the United States. While the labor market in the United States benefits from this shock via an increase in wages, American consumers lose due to their being less variation in the type of goods available and the increase in prices. At the contrary, a trade policy shock in the United States (specifically, a tariff on imports and a subsidy on exports) leaves American (Chinese) consumers slightly worst (better) off. This latter policy also results in an increase (decrease) in the total number of firms in the United States (China).

Chapter I: Cross-Country Differences in Corporate Tax Rates, Anti-Tax Avoidance Rules, and Base Erosion Profit Shifting

1. Introduction

Policy-makers and the public alike are paying increasing attention to issues involving international taxation because, among other reasons, multinational enterprises (MNEs) are using increasingly sophisticated tax planning strategies to minimize their worldwide tax liabilities. For example, cross-country differences in corporate income tax (CIT) rates create incentives for MNEs to manipulate the prices that they use for intracompany transactions (known as transfer prices) to shift profits to countries with more favorable tax treatments. Doing so, without detection by the tax authorities, decreases the MNE's aggregate CIT liabilities and increases its worldwide after-tax profits which, presumably, increases shareholder value. However, such behavior by MNEs erodes the tax bases of countries, like the United States and other OECD countries, with relatively high CIT rates. Clausing (2015) estimates that the United States lost $111 billion in federal CIT revenue in 2012 due to the illegal shifting by U.S.-based MNEs of $371 billion of corporate profits to foreign affiliates.

Generally speaking, a country has two policy options at its disposal to deter so-called base erosion profit shifting (BEPS) by MNEs. They can cut the CIT rate and/or adopt and enforce anti-tax avoidance regulations. Cutting the CIT rate to deter BEPS can be likened to international tax competition to attract mobile capital. The he risk of countries cutting CIT rates is that it will lead to a 'race-to-the-bottom' where governments repeatedly cut CIT rates in response to the tax cuts of other countries in a repeated game of 'tit-for-tat'.

The existing literature on BEPS (Hines Jr & Rice, 1994; Huizinga & Laeven, 2008; Lohse & Riedel, 2013), henceforth HR, HL, and LR, respectively, generally focuses on estimating the semi-elasticity of reported profits with respect to CIT tax-rate differentials among countries (henceforth referred to simply as the semi-elasticity of reported profits).[1] At this point, the alert reader may very well be puzzled. How does the semi-elasticity of reported profits allow tax policy analyst to conclude anything about the effect of CIT-rate differentials among countries on BEPS? The relationship between reported profits and BEPS is relatively straightforward. In contrast to reported profits, which is observable, the true profits and the amount of tax motivated profit shifting by an MNE's affiliate is not observable. However, the reported profit of an MNE's affiliate is equal to its true profit minus the net amount of outbound profit shifting, which may be positive or negative depending on the tax incentives facing the MNE, minus the cost to the affiliate of engaging in intracompany transactions to shift profits to a foreign affiliate. In other words, the reported profit of an MNE's affiliate is a negative function of the net amount of outbound profit shifting in response to cross-country differences in CIT rates. This relationship allows us to infer the effect of CIT-rate differentials on BEPS from the semi-elasticity of reported profits. This explains why the literature has settled upon this approach.

In this paper, I show that the current 'state-of-the-art'- empirical models of reported profits not only result in biased estimates of the semi-elasticities of reported profits, but are also misspecified. First, existing studies fail to account for the stringency with which countries enforce their transfer-pricing rules. Yet, countries with relatively high CIT rates are more likely to adopt and more stringently enforce transfer-pricing rules to mitigate BEPS. Therefore, empirical models of reported profits which do not control for the stringency with which countries enforce their anti-tax avoidance rules may result in inconsistent estimates of the semi-elasticity

[1] I estimate a semi-log specification of a model of reported profits. A semi-elasticity gives the percentage change in the dependent variable in terms of a change of the dependent variable. Algebraically, the semi-elasticity S of a function f at point x is. More specifically, the dependent variable in a semi-log specification of the model is the natural logarithm of an affiliate's reported profits and, on the right-hand-side of the regression equation, is the simple difference in the maximum statutory CIT rate of the host country of the affiliate and that of the host country of the MNE's ultimate owner. As a result, the estimated coefficient of the CIT-rate differential is a semi-elasticity rather than an elasticity which is the interpretation given to the estimated coefficient in a double-log specification (Olsen & Osmundsen, 2003).

of reported profits due to omitted variable bias. To be fair, existing approaches to estimating the semi-elasticity of reported profits do include controls for the adoption of anti-tax avoidance regulations, particularly transfer-pricing rules, by countries over time. However, adopting transfer-pricing rules is necessary but not sufficient to mitigate BEPS. A country must also enforce its rules and apply penalties for detected violations by domestic affiliates of MNEs to deter BEPS.

The second reason that existing practice may result in biased estimates of the semi-elasticity of reported profits is that the CIT-rate differential is potentially endogenous because of international tax competition among countries aimed at stemming BEPS. Again, there are a few studies that use instrumental variables to estimate their models of reported profits (Hines Jr & Rice, 1994; Huizinga & Laeven, 2008); however, the overwhelming majority of studies do not appear to address this issue in the estimation of their models of reported profits.

Third, and certainly most seriously, researchers have not accounted for the incentives of countries to enforce their transfer-pricing rules in the specification of their empirical models of reported profits. More specifically, a country seeking to mitigate BEPS should only monitor the transfer-pricing practices of domestic affiliates of MNEs engaged in intracompany transactions involving foreign affiliates located in countries with lower CIT rates than its own. Since a country's tax administration must use scarce resources to enforce transfer-pricing rules, countries should not monitor the transfer pricing practices of domestic affiliates of MNEs engaging in intracompany transactions involving the foreign affiliates located in countries with higher CIT rates than its own. In this case, the domestic affiliate has no incentive to shift profits to the foreign affiliate; to do so would increase the aggregate tax burden of the MNE. More specifically, countries with high CIT rates should use scarce administrative resources to monitor the transfer pricing practices of domestic affiliates of MNEs engaging in intracompany transactions with foreign affiliates located in low CIT-rate countries. And, researchers striving to provide consistent estimates of the semi-elasticity of reported profits should take these incentives into account when specifying and estimating an empirical model of reported profits.

To address these three concerns, I construct a dummy variable for the stringency with which a country enforces its transfer-pricing rules. The enforcement dummy variable reflects both the level of transfer-pricing documentation that a country requires domestic affiliates of MNEs to submit with its annual CIT return, and the frequency with which the host country applies penalties for violations of its transfer-pricing rules. In constructing the enforcement dummy variable for a given country, the specification of the model accounts for whether the incentives facing the domestic affiliate of the MNE and thus whether the host country should monitor the affiliate's transfer-pricing practices. As discussed in greater detail below, I show that the functional form of the empirical model must be sufficiently flexible to allow for the estimation of potentially three distinct semi-elasticities of reported profits.

In this paper, I develop a theoretical model of tax motivated profit shifting which also accounts for the incentives of countries to enforce their transfer-pricing rules. The comparative statics of the model show that there are potentially three distinct semi-elasticities of reported profits with respect to CIT-rate differentials among countries. Based on this finding, I specify an empirical model of reported profits, which is sufficiently flexible to permit the simultaneous estimation of these three semi-elasticities of reported profits. Specifically, I estimate a semi-elasticity of reported profits when the tax incentives favor outbound (inbound) profit shifting because the host country of the MNE's subsidiary (ultimate owner) has a greater CIT-rate than the host-country of the MNE's ultimate owner (subsidiary). This accounts for two of the three semi-elasticities of reported profits. I estimate a third semi-elasticity of reported profits for the case in which neither country has adopted transfer-pricing rules or fails to enforce them.

Following the existing literature, I estimate my model of reported profits using detailed firm-level data for the period 2008 to 2014. In contrast to the sample periods used in previous studies, my sample period spans the Great Recession.[2] The sample, which is constructed from the Orbis database, contains information on 43,103 affiliates located in 28 countries. Since the sample includes affiliates with ultimate owners located in a variety of developing, developed, and tax haven countries, there is considerable heterogeneity in the combinations of CIT-rate differentials and transfer-pricing enforcement regimes in my sample. This variation should be helpful in identifying the parameter estimates of the model. Using this sample, I estimate a firm-level, instrumental variables, fixed-effects, panel-data model of reported profits to gauge the effect of CIT-rate differentials among countries on reported profits of an MNE's affiliate.

My preferred estimate, when countries enforce their transfer-pricing rules, is -3.2 (-1.0) for the semi-elasticity of reported profits when the tax incentives favor outbound (inbound) profit shifting. The estimated semi-elasticity of -3.2 implies that a 10 percent increase in the CIT-rate differential results in a 32 percent decrease in an affiliates' reported profits due to outbound profit shifting. The estimated semi-elasticity of -1.0 implies that a 10 percent decrease in the CIT-rate differential results in a 10 percent increase in an affiliates' reported profits due to inbound profit shifting. My preferred estimate of the semi-elasticity of reported profit when neither country has adopted transfer-pricing rules or fails to enforce them is equal to -3.5, meaning that a ten percent increase in the CIT-rate differential results in a 35 percent decrease in the affiliates' reported profits.

[2] Orbis is Bureau van Dijk's flagship database of private and listed company information from around the world that emphases the ownership linkages among firms that belong to the same multinational enterprise.

Finally, to illustrate the practical consequences for tax policy analysis of correctly specifying the empirical model of reported profits, I conduct a policy simulation. I assume the United States reduces its CIT rate by 20 percentage points, which results in a proposed-law CIT rate of 15 percent. This is approximately equal to the median CIT rate of OECD countries. I use my preferred estimates of the semi-elasticities of reported profits as well as a single estimate of the semi-elasticity obtained using a state-of-the-art but seriously misspecified model to conduct the policy simulation. This exercise shows that using consistent estimates of the semi-elasticities obtained from a correctly specified model has a substantial effect on the estimated CIT tax revenue effect of the proposed reform.

The remainder of this paper is organized as follows. Section 2 consists of a brief overview of the literature on estimating the semi-elasticity of reported profits. In particular, I focus on those studies that control for the adoption of transfer-pricing rules by countries over time. Section 3 describes a simple theoretical model of tax motived profit shifting by MNEs and analyzes the comparative statics of the model. Section 4 describes the data and construction of the sample used to estimate the empirical model, the econometric specification of the model of profit shifting, and the construction of the variables. Section 5 discusses the empirical results. I report the results of the policy simulation in the subsequent section, and Section 7 concludes.

2. Literature review

It is beyond the scope of the present study to provide a comprehensive review of the vast literature on BEPS.[3] Therefore, we proceed below by reviewing some of the seminal and most relevant papers in this literature.

[3] See Heckemeyer & Overessh (2013) and Dharmapala (2014) for up-to-date and excellent reviews of the literature on BEPS.

The literature on tax-motivated, international profit shifting focuses on gauging the effect of CIT-rate differentials on the reported profit of the affiliates of MNEs. Due to the large variety of methodologies, data, and sample periods used in this literature, it is difficult to compare estimates. Heckemeyer & Overesh (2013), however, seek to provide a consensus estimate of the semi-elasticity of reported profits by conducting a meta-analysis of the available estimates in the literature while controlling for the diversity of approaches. They report a consensus estimate of -0.8, meaning that a 10 percent increase in the CIT-rate differential among countries causes an 8 percent decrease in the reported profits of an MNE's affiliate.

The literature on BEPS generally follows the practice introduced by HR. They assume that the true profit of an MNE's affiliate is generated by a Cobb-Douglas production function, multiply by normalized prices, and subtracting production costs. They further assume that it is a function of capital, labor, and technological change. They use the natural logarithm of these variables as regressors in their empirical model to control for the true profits earned by the MNE's affiliate in a given country. Using aggregate time-series data, HR and Gruber & Mutti (1991) report evidence of a decrease in the reported profits of subsidiaries located in countries with high CIT rates. In addition to not accounting for the enforcement of anti-tax avoidance rules, they do not account for the role of CIT rates in other countries in which an MNE has a presence.

To address the latter issue, HL estimate a model of reported profits using a 1999 cross-section of firm-level data for 12 European countries. They use the weighted-average (by the size of the affiliate) CIT rates of countries in which an MNE has a presence to calculate the CIT-rate differential facing an MNE's affiliate. They report an estimated semi-elasticity of reported profits with respect to the weighted-average, CIT-rate differential of -1.3. (Dischinger, Knoll, &

Riedel, 2014; Lohse & Riedel, 2013) also report evidence consistent with BEPS by MNEs. They show that reported profits are greater (less) than predicted for affiliates located in countries with relatively low (high) CIT rates.

To their credit, Dharmapala & Riedel (2013) and LR make an important methodological contribution to specification of models of reported profit by including a control variable for the existence of transfer-pricing rules by country and over time. As previously discussed, however, the mere existence of transfer-pricing rules is necessary but not sufficient to deter BEPS. Countries must also enforce their anti-tax avoidance regulations if they are going to have a deterrent effect on the tax planning strategies of MNEs. Since I contend that the stringency with which a country enforces its transfer-pricing rules plays an important role in correctly specifying a model of reported profits and consistently estimating the semi-elasticity of reported profits, I proceed below by carefully describing the approaches used in the literature to control for transfer-pricing rules by country and over time.

Although Bartelsman & Beetsma (2003) do not focus on the effect of transfer-pricing rules on BEPS, they do introduce a control variable for transfer-pricing rules as a robustness check of their estimate of the semi-elasticity of reported profits. They do so by constructing an index of transfer-pricing rules for each country in their sample based on the following three criteria: (1) a country's adoption of transfer-pricing rules; (2) the country requires domestic affiliates of MNEs to provide transfer-pricing documentation with its annual CIT return; and (3) the country's adoption of penalties for violating transfer-pricing rules. They estimate their model of reported profits using a sample of 16 countries. As expected, they report evidence that the responsiveness of reported value added to CIT-rate differentials among countries is stronger for observations in countries with less stringent rules than it is for observations located in countries with more stringent rules. The potential limitations of this approach are twofold. First, their estimate may not be identified because of the limited number of countries in their sample which may result in a lack of sufficient variation in the index of transfer-pricing rules. Second, and more importantly, their control variable for the existence of transfer-pricing rules does not account for whether countries are actually assessing penalties on domestic affiliates of MNEs for violations of their transfer-pricing rules.

Lohrse & Riedel (2012, 2013) also include an index for transfer-pricing rules based on a country's documentation requirements. In their specification of the econometric model, they include an interaction term between the index for the existence of transfer-pricing rules and the CIT-rate differential among countries. This allows the estimate of semi-elasticity of reported profits to differ for affiliates of MNEs located in countries with documentation requirements and for those located in countries without such requirements. They conclude that transfer-pricing regulations are an important strategy for governments seeking to deter BEPS. However, they also do not account for whether countries actually enforce for their transfer-pricing rules.

Klessen & Laplante (2012) look deeply into the interaction between the regulatory costs to an MNE's affiliate of the "enforcement" of transfer-pricing rules and a proxy variable for income shifting. They estimate their model using a sample of MNEs located in the United States. Their measure of enforcement is the IRS audit rate for large corporations. This is arguably an imprecise measure of the enforcement of transfer-pricing rules. As a proxy for regulatory costs, they use the weighted average of the existence and enforcement of transfer-pricing rules among the major trading partners of the United States. They conclude that U.S. companies are becoming more active at shifting income out of the United States as the regulatory costs of shifting have changed over time.

Beer & Loeprick (2013) study the effect of the introduction of transfer-pricing rules on the time path of reported profits. They find that within four years of introducing a rule requiring transfer-pricing documentation to be submitted with an MNE's annual CIT return, the reported profits of a subsidiary decreases by approximately 60 percent. Theirs is an innovative way of thinking about the regulator costs of transfer-pricing rules. At the risk of being repetitive, their econometric specification does not include a control variable for whether a country actually enforces its documentation requirements.

The present research makes the following contributions to the literature on BEPS. First, my econometric specification includes a control variable that accounts for the enforcement of transfer-pricing rules. This variable was painfully constructed using information gleaned from reviewing hundreds of reports issued by KPMG and Ernst & Young. Second, in constructing the enforcement dummy variable, I account for the incentives of the host country to enforce its transfer-pricing rules vis-à-vis a foreign affiliate of the MNE based on the prevailing CIT-rate differential between those the host countries. In constructing the enforcement dummy variable, I use the rules of the ultimate owner's host country when that country's top statutory CIT rate is greater than that of the foreign subsidiary's host country and, vice versa, I use the rules of the foreign subsidiary's host country when that country has a top statutory CIT rate that is greater than that of the ultimate owner's host country. The rationale for constructing the enforcement dummy variable in this manner is straightforward: countries should only monitor the transfer-pricing practices when a domestic affiliate of an MNE is engaging in intracompany transactions with a foreign affiliate located in a country with a lower CIT rate than its own. When a domestic affiliate's host country has a lower CIT rate than that for the foreign affiliate's host country, there is simply no risk of BEPS.

Third, consistent with the theoretical predictions of the theory, the specification of my empirical model is sufficiently flexible to allow for the simultaneous estimation of three separate semi-elasticities of reported profit. Fourth, the sample used to estimate the model includes a larger number of countries, including developing, developed, and tax haven countries, than those used in previous studies. Consequently, there is likely to be greater heterogeneity in the sample in terms of the combinations of CIT-rate differentials among countries and the values of the enforcement dummy variable used in this study. The added variation among the independent variables should be helpful in identifying estimated parameters of the model. Fifth, I estimate an instrument variables model to address the potential endogeneity of the CIT-rate differentials among countries in my sample.

3. A simple model of tax motivated profit shifting by an MNE

In this section, we describe a simple model of tax-motivated, international profit shifting of an MNE and derive the comparative statics of the model. The comparative static results of the model are useful in guiding the specification of the empirical model and also provide an entirely new set of testable hypotheses that are an important focus of the econometric exercise discussed in the subsequent section of this study.

3.1. Theoretical model

A fundamental concept in this section is the reported profit of an MNE's affiliate, which is defined as follows:

$$\pi_j^R = \pi_j^T - S_j - \frac{\gamma_j}{2}\frac{S_j^2}{\pi_j^T} \tag{1}$$

Where π_j^R is the reported profit of an MNE's affiliate j (= 1,…, n) located in country J (= 1,…, n); t_J is the CIT rate of country J; π_j^T is the true profit earned by the MNE in country J; S_j is the net amount of outbound profit shifting by the MNE's affiliate j; and $\gamma_J S_j^2 / 2\pi_j^T$ is the total cost to affiliate j of engaging in intracompany transactions to illegally shift profits to a foreign affiliate. These costs are assumed to be increasing in the stringency with which country J enforces its anti-tax avoidance rules, which is denoted by γ_J. This policy parameter is assumed to be greater than or equal to zero. As discussed in greater detail below, I assume that $\gamma_J = 0$, when country J has no incentive to enforce its transfer-pricing rules (because it is receiving revenue from the foreign affiliate). In addition, the total costs of engaging in illegal profit shifting to a foreign affiliate is a positive function of the ratio of the square of the net amount of outbound profit shifting and the true profit of the MNE's affiliate j. The quadratic specification of the cost function captures the assumption that the costs to the affiliate increase with the square of the net amount of illegal outbound profit shifting.

Following HR and HL, we assume that an MNE seeks to maximize worldwide after-tax profits subject to the constraint that the sum of net outbound profit-shifting by all n affiliates of the MNE is equal to zero. Furthermore, I assume an affiliate's net outbound profit shifting may be positive or negative depending on the tax incentives facing the MNE in particular countries. The resulting constrained optimization problem can be written as follows:

$$\max \mathrm{V} = \sum_{\mathrm{j}=1}^{\mathrm{n}} (1 - t_J)\pi_{\mathrm{j}}^{\mathrm{R}} = \sum_{\mathrm{j}=1}^{\mathrm{n}} (1 - \mathrm{t_J}) \left(\pi_{\mathrm{J}}^{\mathrm{T}} - \mathrm{S_j} - \frac{\gamma_{\mathrm{j}}}{2} \frac{\mathrm{S_j^2}}{\pi_{\mathrm{j}}^{\mathrm{T}}} \right),$$
$$\text{subject to } \sum_{j=1}^{n} S_j = 0. \qquad (2)$$

To simplify the model, we assume that the MNE only has two affiliates: a foreign affiliate g located in country G, and an affiliate h located in the MNE's home country H. The Lagrange expression for (2) is given by the following expression:

$$\mathrm{L} = (1-\mathrm{t_G})\left(\pi_g^T - S_g - \frac{\gamma_G}{2}\frac{S_g^2}{\pi_g^T}\right) + (1-\mathrm{t_H})\left(\pi_h^T - S_h - \frac{\gamma_H}{2}\frac{S_h^2}{\pi_h^T}\right) - \lambda(S_g + S_h). \qquad (3)$$

Where λ is a Lagrange multiplier for the constraint that the sum of S_j must equal zero; t_J is the CIT rate of country J (= G, H); π_j^T is the true profit of affiliate j (= g or h) earned in country J (= G or H, respectively); and S_j is the net amount of outbound profits being illegally shifted abroad by affiliate j (= g or h).

Without loss of generality, we assume that the CIT rate of country G is greater than that of country H or $t_G - t_H > 0$. Given the tax incentives created by $(t_G - t_H) > 0$, the MNE should seek to shift profits from the foreign affiliate g to the home affiliate h. This action by the MNE will increase country H's CIT base and consequently its CIT revenues. Given these circumstances, country H has no incentive to spend scarce administrative resources monitoring the transfer pricing practices of a domestic affiliate in so far as it is engaging in intracompany transactions with the foreign affiliate g. There is simply no risk that the domestic affiliate h will seek to shift profits to the foreign affiliate by strategically using transfer prices to understate the true profit earned in country H. If, however, affiliate g is engaging in intracompany transactions with affiliate h, country G should monitor affiliate g's transfer-pricing practices to deter BEPS. Therefore, we assume $\gamma_G > 0$ and $\gamma_H = 0$.

The necessary first order conditions for a maximum are given as follows:

$$\frac{\delta L}{\delta S_i} = -(1-\mathrm{t_I})\left(1 + \frac{\gamma_I S_i}{\pi_i^T}\right) = \lambda. \qquad (4)$$

Where i = g or h, and I = G or H. Solving these two equations simultaneously for affiliate g's optimal level of outbound profit shifting results in the following expression:

$$S_g^* = \frac{t_G - t_H}{\gamma_G}\left(\frac{\pi_g^T}{(1-t_G)}\right) \qquad (5)$$

The signs of the expressions on the right-hand-side of (5) implies that $S_g^* > 0$, meaning that affiliate g should shift profits to affiliate h. This in turn implies that affiliate g's reported profits will be less than the true profits earned in country G. Finally, the constraint $S_g + S_h = 0$ implies that $S_h^* = -S_g^* < 0$, meaning that affiliate h is receiving inbound profit shifting, which, in turn, implies its reported profits are greater than the true profits earned in country H. According to (5), affiliate g's optimal level of outbound profit shifting is positively related to $t_G - t_H$, inversely related to γ_G, and independent of γ_H.

Differentiating (5) by the policy parameters available to country G to deter BEPS, specifically $t_G - t_H$ and γ_G, results in the following two expressions:

$$\frac{\partial S_g^*}{\partial (t_G - t_H)} = \frac{\pi_g^T}{\gamma_G(1 - t_G)} > 0 \text{ and} \tag{6}$$

$$\frac{\partial S_g^*}{\partial \gamma_G} = -\frac{\pi_g^T(t_G - t_H)}{\gamma_G^2(1 - t_G)} < 0. \tag{7}$$

From (6), there is a positive relationship between the CIT-rate differential $t_G - t_H$ and affiliate g's optimal level of outbound profit shifting, and (6) implies that there is a negative relationship between the stringency with which country G enforces its transfer-pricing rules γ_G and affiliate g's optimal level of outbound profit shifting.

As previously discussed, the amount of illegal profit shifting among affiliates of an MNE is not observable; therefore, (6) and (7) are difficult to test empirically. Since an affiliate's reported profits are observable, we recast the comparative static results derived above in terms of the effect of G's policy parameters on affiliate g's optimal level of reported profits. Substituting (5) into (1) and differentiating the resulting expression by the policy parameters available to G to mitigate BEPS, we obtain the following expressions:[4]

[4] Substituting (5) into (1) results in the following expression for affiliate g's optimal level of reported profits:

$$\frac{\partial \pi_g^{R^*}}{\partial(t_G - t_H)} = -\left(\frac{\pi_g^T}{\gamma_G(1-t_G)} + \frac{\pi_g^T\,(t_G - t_H)}{\gamma_G(1-t_G)^2}\right) < 0, \tag{8}$$

$$\frac{\partial \pi_g^{R^*}}{\partial \gamma_G} = \left(\frac{\pi_g^T\,(t_G - t_H)^2}{2{\gamma_G}^2(1-t_G)} + \frac{\pi_g^T(t_G - t_H)}{{\gamma_G}^2(1-t_G)}\right) > 0\text{ , and} \tag{9}$$

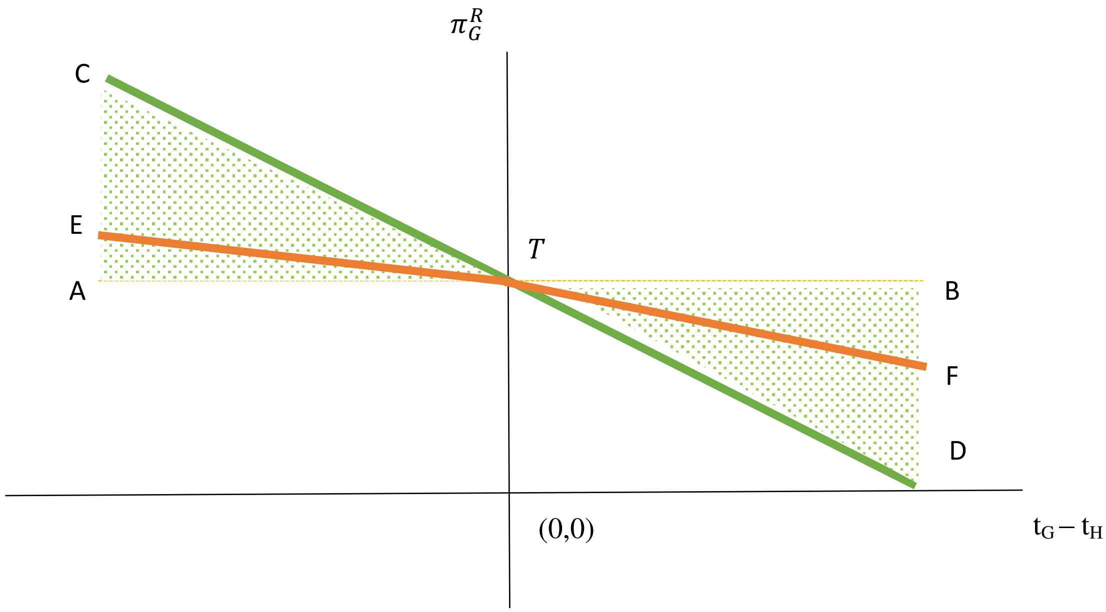
$$\frac{\partial^2 \pi_g^{R^*}}{\partial(t_G - t_H)\partial\gamma_G} = \left(\frac{\pi_g^T}{\gamma_G^2(1-t_G)} + \frac{\pi_g^T\,(t_G - t_H)}{\gamma_G^2(1-t_G)^2}\right) > 0. \tag{10}$$

From (8), there is an inverse relationship between affiliate g's optimal level of reported profits and the CIT-rate differential; (9) shows a positive relationship between affiliate g's optimal level of reported profits and the stringency with which country G enforces its transfer-pricing rules. Finally, (10) implies that increasing the stringency with which country G enforces its transfer-pricing rules decreases (in absolute value) the effect of the CIT-rate differential on affiliate g's optimal level of reported profits. In other words, increasing the stringency with which a country enforces its transfer-pricing rules deters BEPS for every positive value of the CIT-rate differential between countries G and H.

A graph illustrating the implications of (8) - (10) for the relationships between affiliate g's optimal level of reported profits and the CIT-rate differential may help in understanding the comparative static results of this model. Figure 1 illustrates the relationships between affiliate g's optimal level of reported profits and the CIT-rate differential. As we will see, the relationships crucially depend on the stringency with which country G (H) enforces its transfer-pricing rules.

$\pi_g^{R^*} = \pi_g^T\left[1 - \frac{(t_G - t_H)}{\gamma_{G(1-t_G)}} - \frac{(t_G - t_H)^2}{2(1-t_G)^2\gamma_G}\right].$

Figure 1: The Optimal Reported Profits of Affiliate g with Respect to the Corporate Income Tax Rate Differential between Countries G and H



Note: The slope of the line segment labelled $\overline{CD}$ corresponds to β_1 in the econometric specification (10), when $\gamma_G = \gamma_H = 0$. The slope of the line segment labelled $\overline{TF}$ is corresponds to $\beta_1 + \beta_2$ in the econometric specification (10), when $\gamma_G > 0$ and $\gamma_H = 0$. The slope of the line segment labeled $\overline{ET}$ corresponds to $\beta_1 + \beta_3$ in the econometric specification, when $\gamma_G = 0$ and $\gamma_H = 0$.

The vertical axis of Figure 1 represents affiliate g's reported profit $\pi_g^{R^*}$and the horizontal axis represents the CIT-rate differential between countries G and H, which is denoted by (t_G – t_H). The CIT-rate differential can be greater than, less than, or equal to zero. When the CIT-rate differential is equal to zero, there is no incentive for either affiliate to shift profits to the other; therefore, affiliate g's reported profits are equal to its true profits when $t_G = t_H$. This point is labeled T on the vertical axis of Figure 1. Furthermore, if the reported profits of the affiliates are independent of the CIT-rate differential, then affiliate g's reported profits would always be equal to its true profits. Assuming for the sake of simplicity that affiliate g's true profit is exogeneous (i.e., independent of the CIT-rate differential), then affiliate g's reported profit would equal its true profit for every value of ($t_G - t_H$). This case is illustrated by the horizontal line and labeled $\overline{AB}$ and passing through point T. This line provides a useful reference in following discussion.

According to (8) – (10), we must analyze three distinct cases. First, let's suppose neither country adopts transfer-pricing rules in which case $\gamma_G = \gamma_H = 0$. In this case, there is an inverse relationship between affiliate g's optimal level of reported profits and ($t_G - t_H$). This relationship is illustrated in Figure 1 by the negatively sloped line segment labeled $\overline{CD}$. When ($t_G - t_H$) < 0, then affiliate h has an incentive to shift profits to the foreign affiliate g in which case affiliate g's reported profits are greater than its true profits. This is illustrated in Figure 1 by the fact that that the negatively sloped line segment labeled $\overline{CT}$, which represents affiliate g's reported profits, lies above the line labelled $\overline{AB}$, which represents affiliate g's true profits. The vertical distance between $\overline{CT}$ and $\overline{AB}$ represents affiliate h's optimal level of outbound profit shifting, which is equal to the amount of inbound profit shifting received by to affiliate g, for every value of ($t_G - t_H$) < 0.

Now, let's consider the range of the horizontal axis where $t_G - t_H > 0$. In this situation, affiliate g has an incentive to shift profits to firm h, or $S_g^* > 0$, and, as a result, the reported profits of affiliate g are less than its true profits. This is illustrated in Figure 1 by the fact that the negatively sloped line segment labeled $\overline{TD}$, representing affiliate g's optimal level of reported profits, lies below the horizontal line labelled $\overline{AB}$, representing the true profits of affiliate g, for every value of $t_G - t_H > 0$. The vertical distance between $\overline{TD}$ and $\overline{AB}$ represents affiliate g's optimal level of outbound profit shifting at every value of ($t_G - t_H$) > 0.

For purposes of interpreting the empirical model, it is important to observe that the inverse relationship between affiliate g's reported profits and its optimal level of net outbound profit shifting, which can be positive or negative depending on the tax incentives facing the MNE, is evident in Figure 1, as well. As we move from left to right along the horizontal axis, the CIT-rate differential is increasing; reported profits are decreasing; and affiliate g's optimal amount of net outbound profit shifting is increasing. The negatively sloped line labeled $\overline{CD}$ illustrates (8) after setting $\gamma_G = 0$.

Turning to the second case 2, consider the range of the horizontal axis where $t_G - t_H < 0$. As previously discussed, affiliate h has an incentive to shift profits to the foreign affiliate g. Now, in contrast to the previous case, country H enforces its transfer-pricing rules to prevent BEPS. According to (10), enforcement decreases (in absolute value) outbound profit shifting by affiliate h, and, consequently, we assume $\gamma_H > 0$. The effect of country H enforcing its transfer-pricing rules on the optimal level of inbound profits being received by g with respect to the CIT-rate differential is illustrated in Figure 1 by the negatively sloped line segment labeled $\overline{ET}$. This line segment is not as steeply sloped as the line labeled $\overline{CT}$ because country H is enforcing its transfer-pricing rules. This has a deterrent effect on affiliate h's optimal level of outbound profit shifting thus decreasing the amount of inbound profits received by affiliate g at every value of $t_G - t_H < 0$.

The third case arises when $t_G - t_H > 0$, and country G enforces its transfer pricing rules to deter BEPS, thus $\gamma_G > 0$. Again, according to (10) enforcement decreases (in absolute value) affiliate g's optimal level of net outbound profit shifting at every value of $t_G - t_H > 0$. This is illustrated in Figure 1 by the negatively sloped line segment labeled $\overline{TF}$. Again, this line segment is not as steeply sloped as the line segment $\overline{TD}$ because of the deterrent effect of country G enforcing its transfer-pricing rules on affiliate g's optimal level of outbound profit shifting.

I conclude this section with a couple of final observations. First, the line segment labeled $\overline{EF}$ may not have a constant slope. Indeed, there should be a kink in $\overline{EF}$ at the point labelled T on the vertical axis of Figure 1 if $\gamma_G \neq \gamma_H$, meaning that one country is enforcing its transfer-pricing rules, when it has the incentive to do so, more stringently than the other country. Consequently, the functional form of the empirical model should be flexible enough to permit the simultaneous estimation of three distinct semi-elasticities of reported profit. Second, for expository reasons, I assume that true profits are exogenous. If, however, a country's CIT rate distorts the real activity of domestic affiliates of MNEs, as seems likely, then this could be illustrated in Figure 1 by rotating the three lines counter-clockwise about the point labeled T on the vertical axis. This also shows the necessity of controlling for true profits in the empirical model.

In this section, we describe the data and the construction of the sample used to estimate the empirical model, the econometric specification of the empirical model of reported profits, and the variable construction.

3.2. The data and sample construction

To estimate the model, I use firm-level data. Such data are not readily available. At the moment, there are only three government entities that collect information on MNEs: The Bureau of Economic Analysis's (BEA) Operations and Management Companies Database in the U.S., Deutsche Bundesbank's Microdatabase on Direct Investments (MIDI), and the United Kingdom's Office for National Statistics annual inquiry into Foreign Direct Investment (AFDI). Unfortunately, these databases are not publicly available. Fortunately, some private institutions, such as Capital IQ (COMPUSTAT and Capital IQ Platform) and Bureau Van Dijk-BvD (Orbis and Amadeus), offer various platforms that contain information on company profits, costs, performance, and other indicators. These datasets are frequently used by firms providing accounting services to MNEs and by tax enforcement authorities, such as the IRS to take one example. These data are often used by scholars interested in corporate finance and international tax issues and are frequently cited in the academic literature.

I construct a sample of affiliates of MNEs from the Orbis (BvD) database which contains information on over 200 million private companies worldwide. One of the limitations of using these data for the task at hand is that ownership information is only available for the most recent year of the data. Indeed, when applying the match of the current year to prior years, it is possible to obtain mismatches between parents and subsidiary firms, particularly when there have been mergers and acquisitions during the intervening years. As noted in previous studies that use these data (Dharmapala & Riedel, 2013; Dischinger et al., 2014; Huizinga & Laeven, 2008), this is an unfortunate but unavoidable limitation of using these data. [5]Since mergers and acquisitions are relatively infrequent events (Huizinga & Laeven, 2008), particularly during the time period spanned by my sample, I believe that any bias resulting from using these data is relatively small.

I construct the sample, which I use to estimate the model, from the Orbis database by excluding firms with the following characteristics: firms with subsidiaries, inactive firms, firms with losses, non-industrial firms (banks, hedge funds, foundations, insurance, public authorities, trustees, venture capital, and others), small firms as defined by Orbis and firms with an ultimate owner located in the same country.[6] Ultimate owners are excluded from the sample to prevent perfect multicollinearity due to the adding-up constraint that profit-shifting must sum to zero. Loss-making firms are excluded from the sample because they are subject to specific accounting rules; incorporating these rules into the empirical model is beyond the scope of the current study.

[5] Fifty percent of the data available are lost due to these selection criteria.

[6] Ultimate owners are excluded from the data set because the same semi-elasticity of BEPS is calculated using the differential between an affiliate of an MNE and its ultimate owner.

After applying these exclusion criteria to the dataset, the resulting sample consists of 48,309 subsidiaries for the period 2008 to 2014. Tables 1 and 2 report the number subsidiaries and ultimate owners in the sample by country, respectively. I augment the firm-level data with country-level data drawn from a variety of sources, as discussed in greater detail below.

Table 1: Number of affiliates in the sample by country

Country	Number of affiliates
1. Australia	5
2. Austria	895
3. Belgium	2,959
4. Britain	4,386
5. Cyprus	39
6. Czech	3,108
7. Denmark	1,194
8. Estonia	631
9. Finland	886
10. France	6,161
11. Germany	3,584
12. Hong Kong	5
13. Iceland	14
14. Ireland	743
15. Italy	4,044
16. Japan	156
17. Luxembourg	40
18. Netherlands	779
19. New Zealand	725
20. Norway	1,273
21. Portugal	1,858
22. Slovakia	1,892
23. Slovenia	546
24. South Korea	995
25. Spain	3,838
26. Sweden	2280
27. Switzerland	46
28. United States	21
Total number of affiliates	43,103

Table 2: Host countries of the ultimate owners (in alphabetical order)

Country	Number of firms	Country	Number of firms	Country	Number of firms
Andorra	10	Greece	42	Peru	1
Angola	9	Guinea-Bissau	1	Philippines	3
Argentina	13	Hong Kong	165	Poland	184
Australia	490	Hungary	73	Portugal	255
Austria	1,300	Iceland	52	Romania	26
Bahamas	30	India	291	Russian Federation	102
Bahrain	3	Indonesia	4	Saint Vincent	4
Barbados	2	Ireland	504	Saudi Arabia	24
Belarus	2	Israel	172	Serbia	10
Belgium	1,058	Italy	1,825	Seychelles	21
Bermuda	198	Japan	2,295	Singapore	174
Bosnia	5	Korea, Republic of	231	Slovakia	87
Brazil	60	Kuwait	24	Slovenia	40
Bulgaria	31	Latvia	34	South Africa	50
Canada	450	Lebanon	36	Spain	1,171
Cayman Isl.	196	Liechtenstein	107	Sri Lanka	4
Chile	18	Lithuania	43	Sweden	1,726
China	319	Luxembourg	1626	Switzerland	1,961
Colombia	14	Macedonia	1	Syria	1
Costa Rica	2	Malaysia	58	Taiwan	142
Croatia	47	Malta	104	Thailand	12
Cyprus	287	Marshall Islands	17	Tunisia	10
Czech Rep.	291	Mauritius	21	Turkey	73
Denmark	1,281	Mexico	50	Ukraine	43
Ecuador	1	Monaco	22	UAE	91
Egypt	3	Morocco	8	United Kingdom	2,921
Estonia	18	Namibia	1	United States	7,234
Finland	777	Netherlands	1,992	Uruguay	3
France	2,957	New Zealand	63	Venezuela	8
Georgia	1	Norway	811	Viet Nam	2
Germany	6,107	Panama	67	Total	43,103

3.3. The econometric specification

To test the predictions derived from the theoretical model, I adapt the econometric specification pioneered by HR and HL. More specifically, I estimate the following fixed-effects, instrumental variables, panel data model:

$$Log(\pi^r_{gt}) = \beta_0 + \beta_1(t_{Gt} - t_{Ht}) + \beta_2(t_{Gt} - t_{Ht})\gamma_{Gt} + \beta_3(t_{Gt} - t_{Ht})\gamma_{Ht} + \beta_4\gamma_{Gt} + \beta_5\gamma_{Ht}$$
$$+ \beta_6 \log(k_{gt}) + \beta_7 \log(l_{gt}) + \beta_8 Log(a_{Gt}) + \beta_9\omega_{Gt} + \sum \sigma_{st} + u_{gt}. \quad (10)$$

The dependent variable is the natural logarithm of affiliate g's reported profits in country G and year t. The CIT-rate differential for countries G and H, respectively, in year t, is denoted by t_{Gt} - t_{Ht}, and, as discussed in greater detail below, γ_{Gt} and γ_{Ht} are dummy variables reflecting the stringency with which countries G and H, respectively, enforce their transfer-pricing rules while also accounting for their incentives to do so. The interaction terms involving the CIT-rate differential and the enforcement dummy variables provide the necessary flexibility to estimate the three distinct semi-elasticities of reported profits predicted by the theory.

The right-hand-side variables k_{gt} and l_{gt}, denote the value of firm g's capital assets and labor costs, respectively. The variable a_{Gt} denotes country G's real GDP per capita, which serves as a proxy variable for the rate of technological change. Following the methodology pioneered by HR, these variables are included in the model to control for the true profit earned by affiliate g in country G. The variable ω_{Gt} is a vector of country and time specific characteristics, namely indexes of trade freedom and political stability; σ_{st} is an industry-year fixed effect; and u_{gt} is a stochastic-error term, which is assumed to be normally distributed with mean zero and constant variance.

The model is estimated using an instrumental variable for the potentially endogenous variables in (10) involving the CIT-rate differential. Following HR and HL, I use the log difference in the populations of the affiliates' and ultimate owner's host countries as an instrument for the potentially endogenous variable. The intuition behind using this instrument is that tax haven countries tend to be sparsely populated island countries, often located in the Caribbean. In contrast, high CIT-rate countries tend to be more populous OECD countries. I conduct Hausman-Wu specification tests for each model. These tests reject the null hypothesis that the variables involving the CIT-rate differential are exogeneous. I also conduct a Wright-Yogo test which rejects the null hypothesis that the log difference in populations is a weak instrument. In short, I believe that the log difference in populations is a valid instrument. It is sufficiently correlated with the potentially endogenous variables. Furthermore, there is no reason to believe that it belongs in the model of reported profits; so the exclusion restriction is valid, as well.

3.4. Construction of the variables

The dependent variable is measured by the natural logarithm of reported earnings before interest and taxes (EBIT). Firm-level information on reported EBIT, the value of fixed assets, and labor costs by year are from the Orbis database. The CIT-rate differential is constructed using the maximum statutory CIT rates of an affiliate's and ultimate owner's host countries. These data come from Bloomberg and various issues of Ernst & Young's Worldwide Corporate Tax Guides, KPMG's Global Corporate Tax Summaries, and Price-Waterhouse-Cooper's Global Corporate Tax Summaries.

The stringency with which a country enforces its transfer-pricing rules is a dummy variable which is built by the product of two constructed variables. One of the constructed variables is a trichotomous variable reflecting the level of documentation that a country requires a domestic affiliate of MNE to submit with its CIT return. The second constructed variable is also a trichotomous variable reflecting the frequency with which a country applies penalties for violating its transfer-pricing documentation requirements. Information used to construct these variables comes from Ernst & Young's Worldwide Transfer Pricing Reference Guide and KPMG's Transfer Pricing Review by country and by year. Table 3 summarizes the criteria used to construct the categorical variables measuring the level of a country's documentation requirements and the frequency with which a country applies penalties for failing to comply with its transfer-pricing documentation requirements.

Table 3: Coding of the categorical variables according to a country's transfer-pricing documentation requirements and application penalties for violations

Report	Documentation requirements		Penalties applied for violations	
	KPMG's Transfer Pricing Review	EY's Worldwide Transfer Pricing Reference Guide	KPMG's Transfer Pricing Review	EY's Worldwide Transfer Pricing Reference Guide
Information provided in the report	Are transfer-pricing required to be submitted on an annual basis?	Documentation requirements and return disclosures and related-party disclosures	To what extent are transfer pricing penalties enforced?	Audit risk/transfer pricing scrutiny
Coding	Answers to the questions stated above			
0	No	No documentation required.	Never	None
1	No, but documents need to be prepared when requested	Documents are required when a firm is audited and a firm has some time to prepare them.	Not often	Low risk
2	No, but documents need to prepared along with the tax return	Documents need to be ready when requested.	Increasing	Medium risk
3	Yes	Documents need to be summited with the annual CIT return	Often or always	High risk

The product of these two constructed categorical variables results in a variable with the following six values: 1, 2, 3, 4, 6, and 9. For ease of reference, let's refer to this variable as the stringency measure. The enforcement dummy variable in (10) is constructed by setting it equal to one when the stringency measure is greater than or equal to four, and zero otherwise. To test the robustness of the model, as discussed in greater detail below, I also estimate a specification in which the enforcement variable is set equal to one when the stringency measure is greater than or equal to five. This change in the definition of the enforcement dummy variable has no appreciable effect on the estimated coefficients.

Data on GDP per capita and the index of trade freedom by country and year come from the World Bank's Development Indicators (World Bank Group) and the Heritage Foundation's Index of Economic Freedom, respectively. Table 4 reports sample summary statistics.

Table 4: Summary statistics for the full sample

Variable	Mean	Standard deviation	Minimum	Maximum	Source
CIT-rate differential ($t_G - t_H$)	-0.022	0.090	-0.425	0.407	Author
Average CIT-rate differential	0.009	0.041	-0.167	0.190	Author
Enforcement regime by the subsidiary's host country	0.259	0.438	0.000	1.000	Author
Enforcement by the ultimate owner's host country	0.656	0.475	0.000	1.000	Author
Transfer-pricing rules in the subsidiary's host country	0.991	0.091	0.000	1.000	Author
Transfer-pricing rules in the ultimate owner's host country	0.909	0.288	0.000	1.000	EY, KPMG
Transfer-pricing documentation required by the subsidiary's host country	0.149	0.357	0.000	1.000	EY, KPMG
Transfer-pricing documentation required by the ultimate owner's host country	0.086	0.280	0.000	1.000	EY, KPMG
Log(subsidiary's reported profits)	6.426	1.836	-11.236	15.614	ORBIS
Log(value of fixed assets)	6.559	2.626	-6.001	17.635	Author
Log(labor costs)	7.610	1.554	-4.977	16.486	Author
Log(GDP per capita)	10.521	0.386	9.592	11.667	ORBIS
Index of trade freedom[c]	68.442	15.544	38.500	96.000	ORBIS
Index of political stability	0.698	0.392	-0.466	1.514	World Bank

Note: the number of observations is 190,862.

4. The empirical results

Now, we turn to the discussion of the empirical results. Since the focus of this research is obtaining consistent estimates of the semi-elasticities of reported profits, I report estimates of this parameter for a variety of specifications in Table 5. All specifications include a full set of firm and industry-year fixed effects, and I report robust standard errors clustered at the MNE level.

Table 5: Instrumental variable estimates of the semi-elasticity of reported profits

Empirical specification	Semi-elasticity of reported profits		
	β_1 (without transfer-pricing rules)	$\beta_1 + \beta_2$ (country H has no incentive to enforce its transfer-pricing rules)	$\beta_1 + \beta_3$ (country G has no incentive to enforce its transfer-pricing rules)
	Models are estimated on the full sample		
First-generation model	-1.789***	-	-
Second-generation model A	-1.589***	-1.039	-
Second-generation model B	-9.435*	-1.811***	-
Enforcement model 1	-3.54***	-3.063*	-1.286**
	Model is estimated on the subsample in which $t_G - t_H > 0$		
Enforcement model 2	-4.741*	-3.225*	-1.648
	Models are estimated on the subsample in which $t_G - t_H < 0$		
Enforcement model 3	-4.438*	-4.040	-1.041*

Note: The dependent variable in these models is the natural logarithm of earnings before interest and taxes (EBIT). The second-generation model A includes a dummy variable = 1 if the subsidiary's host country requires transfer-pricing documentation to be submitted with the affiliate's annual CIT return and zero otherwise. The second-generation model B includes a dummy variable = 1 if the for the subsidiary's host country has adopted transfer-pricing rules and zero otherwise. The enforcement model includes a dummy variable = 1 if the host country of the subsidiary enforces transfer-pricing rules. The instrument for the potentially endogenous variable (CIT-rate differential) is the log of the difference in populations of the two countries.

For the sake of comparison, I estimate a "first-generation model of reported profits," using my sample. This specification does not include a control variable for countries with transfer pricing rules. This estimate of the semi-elasticity of reported profits is reported in the row labelled First-generation model and the second column of Table 5. The estimate is equal to -1.789 and it is distinguishable from zero at conventional levels of statistical significance. This estimate has the expected sign. The full set of estimated coefficients for this specification are reported in the second column of Table 6. For reasons previously discussed, I believe this model is misspecificied and the estimate of the semi-elasticity is inconsistent.

Table 6: Instrumental variable estimates of alternative models of reported profits

Variable	Empirical specification			
	First generation	Second generation A	Second generation B	Enforcement model
IT-rate differential ($t_G - t_H$)	-1.798*** (0.633)	-1.589*** (0.512)	-9.435* (5.002)	-3.540*** (1.244)
Transfer-pricing documentation required by subsidiary's host country (TPD-SHC)	-	0.050** (0.023)	-	-
TPD-SHC×($t_G - t_H$)	-	0.550 (0.352)	-	-
Existence of transfer-pricing rules in the subsidiary's country (ETPR-SHC)	-	-	1.441* (0.810)	-
ETPR-SHC ×($t_G - t_H$)	-	-	7.624* (4.379)	-
Enforcement by subsidiary's host country (E-SHC)	-	-	-	-0.026 (0.019)
E-SHC ×($t_G - t_H$)	-	-	-	0.477** (0.189)
Enforcement by ultimate owner's host country (E-UHC)	-	-	-	-0.081*** (0.019)
E-OHC ×($t_G - t_H$)	-	-	-	2.254** (0.928)
Log(value of fixed assets)	0.045*** (0.003)	0.045*** (0.003)	0.045*** (0.003)	0.045*** (0.003)
Log(labor costs)	0.447*** (0.006)	0.447*** (0.006)	0.447*** (0.006)	0.448*** (0.006)
Log(GDP per capita)	0.788*** (0.037)	0.795*** (0.037)	0.776*** (0.034)	0.804*** (0.034)
Index of trade freedom	0.012*** (0.002)	0.012*** (0.002)	0.012*** (0.002)	0.014*** (0.002)
Number of observations	190,862	190,862	190,862	190,862
R-squared	0.048	0.048	0.045	0.048
Number of subsidiaries	38,314	38,314	38,314	38,314

Notes: The dependent variable in these models is the natural logarithm of earnings before interest and taxes (EBIT). Heteroscedasticity robust standard errors adjusted for MNE clusters are reported in parentheses. $*$, $**$, $***$ indicates statistical significance at the 10-percent, 5-percent, and 1-percent levels. The unit of observation is active subsidiaries of MNEs by year. All specifications include affiliate-level fixed effects. Each specification also includes 130 industry-year dummy variables (NACE Rev.1 1-digit level).

Second-generation models include a variety of ways to control for whether a country has transfer-pricing rules. Accordingly, I estimate two versions of the second-generation model, using my sample. In version of the model that I refer to as the second-generation model A, I follow the practice in the literature of controlling for whether a country has adopted transfer-pricing rules by including a dummy variable equal to one when the subsidiary's host country requires that the affiliates of MNEs submit documentation of their transfer-pricing practices. This generation of models includes an interaction term between the CIT-rate differential and the dummy variable controlling for the adoption of transfer-pricing rules. As a result, there are two distinct estimates of the semi-elasticity of reported profits. There is an estimate for the case in which the host country does not have transfer pricing rules, and there is an estimate for the case in which the host country of the subsidiary requires submission of documentation of the affiliates' transfer pricing practices. The former estimate is reported in the row labelled Second-generation model A and the second column of Table 5. This estimate is equal to -1.589. Consistent with the theory, the estimate is negative and statistically different from zero at conventional levels of significance. The latter estimate is equal to -1.039; however, it is not distinguishable from zero at conventional levels of statistical significance. The estimated coefficients for this specification are reported in the third column of Table 6.

In the specification that I refer to as the second-generation model B, I follow the practice in the literature of controlling for a country's adoption of transfer-pricing rules, which may or may not include documentation of the affiliates' transfer-pricing practices, by including a dummy variable set equal to one when the host country of the subsidiary has adopted transfer-pricing rules of some type and zero otherwise. I also include an interaction term between the CIT-rate differential and the dummy variable controlling for foreign subsidiary's adoption of transfer-pricing rules. The estimates of the semi-elasticity of reported profits are reported in the row labelled second-generation model B of Table 5 and are equal to -9.435 and -1.811, respectively. Consistent with the theory, the estimates are negative and statistically different from zero at conventional levels of significance.

Second-generation models are an improvement over first-generation model because they control for whether countries have adopted transfer-pricing rules. However, for these reasons previously discussed, these models are misspecified and the estimated semi-elasticities are inconsistent. These models do not account for which country – the host country of the subsidiary or of the ultimate owner – has adopted transfer-pricing rules, enforces these rules, and has the incentive to do so.

Now, I estimate (10) in which I include a dummy variable to control for whether a country enforces its transfer-pricing rules and which country – the host of the affiliate or the ultimate owner -- has an incentive to do so. In this specification of the model, there are two interaction terms with the CIT-rate differential. There is an interaction term for the case in which the host country of the affiliate (ultimate owner) has adopted transfer-pricing rules and has the incentive to enforce them. Therefore, this specification results in three potentially distinct values of the semi-elasticity of reported profits.[7] The estimated coefficients of this specification are reported in the fourth column of Table 6.

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[7] These three semi-elasticities are defined in terms of (10) by the following expressions: $\frac{dE\left[\ln\left(\pi_g^R\right)|t_G-t_H\geq 0,\gamma_G=0\gamma_H,=0\right]}{d(t_G-t_H)}=\beta_1$; $\frac{dE\left[\ln\left(\pi_g^R\right)|t_G-t_H\geq 0,\gamma_G=1,\gamma_H=0\right]}{d(t_G-t_H)}=\beta_1+\beta_2$; and $\frac{dE\left[\ln\left(\pi_g^R\right)|t_G-t_H<0,\gamma_G=0,\gamma_H,=1\right]}{d(t_G-t_H)}=\beta_1+\beta_3$, where the subscripts G and H are for the host country of the affiliate and ultimate owner, resespectively.

The estimated semi-elasticity for the case in which neither country enforces its transfer-pricing rules is reported in the row labeled Enforcement model 1 and the second column of Table 5. The estimated semi-elasticity is equal to -3.540 and is distinguishable from zero at conventional levels of statistical significance. This estimate implies a ten-percent increase in the CIT-rate differential results in a 35 percent decrease in reported profits, which is substantial. The estimate reported in the corresponding row and third column of Table 5 is for the case in which the foreign affiliate's host country has adopted, enforces its rules, and has the incentive to do so because $t_G - t_H > 0$. This estimate of the semi-elasticity of reported profits is equal to -3.063, meaning that a ten-percent increase in the CIT-rate differential results in an approximately 30 percent decrease in reported profits. Consistent with the theory, this estimate is negative and statistically distinguishable from zero at the ten-percent level. Furthermore, it is somewhat greater (in absolute value) than the previous estimate when countries do not enforce transfer-pricing rules. As reported in the corresponding row and third column of Table 5, the semi-elasticity of reported profits is equal to -1.286 and is statistically distinguishable from zero at the 5-percent level. This semi-elasticity corresponds to the case in which the ultimate owner's host country has adopted transfer-pricing rules, enforces its rules, and has the incentive to do so because $t_G - t_H < 0$. This estimate implies a ten-percent increase in the CIT-rate differential results in an approximately 13 percent decrease in reported profits. As predicted by the theory, this estimate is smaller (in absolute value) than the estimate when neither country enforces its rules. It is also interesting to note that the estimates for the cases when the subsidiary's and ultimate owner's host countries have the incentive to enforce their rules differ, as well.

Now, I estimate (10) on two subsamples to test the key assumption that accounting for the incentive of a country to enforces its transfer-pricing rules is important for correctly specifying a model of reported profits. In the row labeled Enforcement 2, I report the estimates of the semi-elasticities of reported profits on the subsample in which the CIT-rate differential is positive or $(t_G - t_H) > 0$. In this case, the affiliate's host country G has an incentive to enforce its transfer-pricing rules to mitigate BEPS, but the ultimate owner's host country does not. Consistent with the theory, the semi-elasticity for the case in which the host country of the affiliate has the incentive to enforce its rules is negative and statistically distinguishable from zero at the ten-percent level, but, as predicted by theory, the estimate when the ultimate owner's host country enforces its rules but has no incentive to do so is indistinguishable from zero at conventional levels of statistical significance. I repeat the same exercise on the subsample in which the CIT-rate differential is negative or $(t_G - t_H) < 0$. In this case, the ultimate owner's host country has an incentive to enforce its rules but the foreign affiliate's host country does not. The estimated semi-elasticities for this subsample are reported in the row labelled Enforcement model 2. Consistent with the theory, the semi-elasticity for the case in which the ultimate owner's host country has the incentive to enforce its rules, which is reported in column 3 of Table 5, is negative and statistically different from zero at conventional levels of significance. And, as predicted by the theory, the estimate for the case in which the foreign affiliate's host country enforces its rules but has no incentive to do so because $(t_G - t_H) < 0$ is indistinguishable from zero at conventional levels of statistical significance. These placebo estimates provide important evidence that is consistent with the theory. In specifying a model of reported profits, the functional form should be sufficiently flexible to permit the estimation of three semi-elasticities of reported profits. Furthermore, the construction of the enforcement dummy variable should account for not only whether the country has adopted rules and enforces them but should also account for whether the country has the incentive to enforce its rules given the tax incentives facing domestic affiliates of MNEs engaging in intracompany transactions with foreign affiliates. The estimated coefficients obtained from these two subsamples are reported in columns 2 and 3, respectively, of Table 7.

Table 7: Instrumental variable estimates of the enforcement model of reported profits

Variable	Sample		
	Full	CIT-rate differential is positive $(t_G - t_H) > 0$	CIT-rate differential is negative $(t_G - t_H) < 0$
CIT-rate differential $(t_G - t_H)$	-3.540*** (1.244)	-4.741* (1.172)	-4.438* (1.809)
Existence of transfer-pricing rules in the subsidiary's host country (ETPR-SHC)	-0.001 (0.020)	-0.081*** (0.031)	0.008 (0.036)
ETPR-SHC×$(t_G - t_H)$	0.477** (0.189)	1.516* (0.900)	0.392 (0.336)
Existence of transfer-pricing rules in the ultimate owner's host country (ETPR-UHC)	-0.026 (0.019)	-0.161 (0.214)	0.092 (0.078)
ETPR-UHC×$(t_G - t_H)$	2.254** (0.928)	3.093 (4.311)	3.397** (1.600)
Log(value of fixed assets)	0.045*** (0.003)	0.042*** (0.005)	0.044*** (0.004)
Log(labor costs)	0.448*** (0.006)	0.433*** (0.010)	0.462*** (0.008)
Log(GDP per capita)	0.804*** (0.034)	0.733*** (0.065)	0.857*** (0.043)
Index of trade freedom	0.0138*** (0.002)	0.0171*** (0.003)	0.0120*** (0.003)
Number of observations	190,862	80,702	107,730
R-squared	0.048	0.041	0.053
Number of affiliates	38,314	17,137	22,475

Notes: The dependent variable in these models is the natural logarithm of earnings before interest and taxes (EBIT). Heteroscedasticity robust standard errors adjusted for MNE clusters are reported in parentheses. ∗, ∗∗, ∗∗∗ indicates statistical significance at the 10-percent, 5-percent, and 1-percent levels. The unit of observation is active subsidiaries of MNEs by year. All specifications include affiliate-level fixed effects. Each specification also includes 130 industry-year dummy variables (NACE Rev.1 1-digit level.

To gauge the robustness of the main results to alternative specifications, estimate a specification of the model in which I add a control variable for political stability. The estimated coefficients of this specification are reported in columns 1-3 of Table 8. This model is estimated on the full sample and the two subsamples previously described. The estimated coefficients have the expected signs and statistical significance. Next, I examine the robustness of my main findings to an alternative definition of the stringency with which a country enforces its rules. More specifically, I redefine γ_{Gt} and γ_{Ht} to be equal to one when the constructed categorical variable for the frequency of applying penalties is equal to or greater than six rather than four as in the case of the previous specifications. The estimated coefficients of this specification are reported in columns 4-6 of Table 8. Again, I estimate this specification on the full sample and the two subsamples previously described. The estimated coefficients of this specification have the expected signs and statistical significance.

Table 8: Robustness of the main results to the inclusion of a political stability index and to an alternative definition of enforcement

Variable	Includes an index of political stability			Alternative definition of enforcement		
	Sample			Sample		
	Full	$(t_G - t_H) > 0$	$(t_G - t_H) < 0$	Full	$(t_G - t_H) > 0$	$(t_G - t_H) < 0$
CIT-rate differential $(t_G - t_H)$	-3.518*** (1.245)	-6.217* (4.920)	-4.049** (1.806)	-2.977*** (1.006)	-2.709 (5.297)	-2.980** (1.260)
Enforcement by subsidiary's host county (E-SHC)	-0.0111 (0.0209)	-0.0921*** (0.0303)	-0.00869 (0.0363)	0.006 (0.023)	-0.043 (0.052)	0.007 (0.035)
E-SHC×$(t_G - t_H)$	0.393** (0.192)	1.637* (0.881)	0.266 (0.337)	0.661*** (0.233)	0.682* (0.253)	0.464 (0.338)
Enforcement by ultimate owner's host county (E-UHC)	-0.0236 (0.0188)	-0.219 (0.205)	0.0818 (0.0782)	0.044** (0.018)	0.113 (0.168)	0.024 (0.064)
E-UHC×$(t_G - t_H)$	2.237** (0.929)	4.290 (4.107)	3.087* (1.596)	1.715** (0.679)	1.853 (2.841)	2.272* (1.214)
Log(value of fixed assets)	0.045*** (0.00301)	0.042*** (0.00499)	0.044*** (0.004)	0.045*** (0.003)	0.044*** (0.005)	0.044*** (0.004)
Log(labor costs)	0.450*** (0.006)	0.433*** (0.010)	0.462*** (0.009)	0.448*** (0.006)	0.428*** (0.011)	0.463*** (0.008)
Log(GDP per capita)	0.447*** (0.00613)	0.433*** (0.00959)	0.844*** (0.0436)	0.794*** (0.035)	0.770*** (0.068)	0.849*** (0.044)
Index of trade freedom	0.013*** (0.002)	0.015*** (0.003)	0.0109*** (0.003)	0.015*** (0.002)	0.01 (0.003)	0.012*** (0.003)
Political stability index	0.0719*** (0.0195)	0.0779** (0.0308)	0.0827*** (0.0263)	-	-	-
Number of observations	190,862	80,702	107,730	190,862	80,702	107,730
R-squared	0.048	0.041	0.053	0.048	0.041	0.053
Number of affiliates	38,314	17,137	22,475	38,314	17,137	22,475

Notes: The dependent variable in these models is the natural logarithm of earnings before interest and taxes (EBIT). The estimates of reported in right-hand-side panel of the table uses an alternative definition the dummy variable for a country's enforcement of transfer-pricing rules. The dummy variable = 1.0 when the constructed categorical variable is greater than or equal to 5 (rather than 4) and zero otherwise. Heteroscedasticity robust standard errors adjusted for MNE clusters are reported in parentheses. *, **, *** indicates statistical significance at the 10-percent, 5-percent, and 1-percent levels. The unit of observation is active subsidiaries of MNEs by year. All specifications include affiliate-level fixed effects. Each specification also includes 130 industry-year dummy variables (NACE Rev.1 1-digit level).

5. Policy simulation

To illustrate the practical consequences for tax policy analysis of correctly specifying the empirical model of reported profits, I report describe the results of a policy simulation in this section. For purposes of the simulation, I assume the United States reduces its CIT rate by 20 percent. A 20 percent cut in the top statutory CIT rate of the U.S. would be equivalent to a tax rate of 15 percent, instead of the current-law rate of 35 percent. This proposal is particularly relevant because the United States has one of the highest top statutory CIT rates in the world, and there is an ongoing policy debate about the merits of the United States reducing its top statutory CIT rate to make it more competitive with that of other countries.

For the sake of comparison, I use the estimated semi-elasticities for reported profits obtained from the First–generation model reported and Enforcement model 1, which are reported in the corresponding rows of Table 5, to provide two estimates of the policy simulation. The estimates for the policy simulation based on the First-generation model of the effect of the proposal on the percent change in reported CIT revenue by country and on the percent change in aggregate reported firm EBIT by country are reported in columns two and three, respectively, of Table 9, Similarly, the estimates for the policy simulation based on the Enforcement 1 model are reported in columns four and five, of Table 9.[8]

[8] The simulation for the first generation model I used column 1 if Table 6. [8] To run the simulation for the enforcement model I used column 4 if Table 6

Table 9: Policy simulation of the effect of the United States decreasing its CIT rate to 15 percent

Country	Based on the first-generation model: Percent change in tax revenue by country	Based on the first-generation model: Percent change in the sum of affiliate's reported profits by country	Based on the enforcement model: Percent change in tax revenue by country	Based on the enforcement model: Percent change in the sum of affiliate's reported profits by country
Austria	-4.48	-4.48	-2.53	-2.53
Belgium	-5.79	-5.79	-4.34	-4.34
Britain	-8.33	-8.33	-6.25	-6.25
Czech	-3.22	-3.22	-2.41	-2.41
Denmark	-5.40	-5.40	-2.67	-2.67
Estonia	-1.76	-1.76	-1.32	-1.32
Finland	-5.13	-5.13	-3.85	-3.85
France	-4.88	-4.88	-3.66	-3.66
Germany	-5.29	-5.29	-2.62	-2.62
Iceland	-4.32	-4.32	-3.24	-3.24
Ireland	-9.03	-9.03	-6.78	-6.78
Italy	-5.03	-5.03	-3.77	-3.77
Japan	-6.27	-6.27	-4.71	-4.71
Netherlands	-5.91	-5.91	-4.43	-4.43
New Zealand	-8.91	-8.91	-6.69	-6.69
Norway	-3.22	-3.22	-2.42	-2.42
Portugal	-3.09	-3.09	-1.53	-1.53
Slovenia	-2.48	-2.48	-1.86	-1.86
South Korea	-5.56	-5.56	-3.93	-3.93
Spain	-4.65	-4.65	-2.47	-2.47
Sweden	-4.35	-4.35	-3.27	-3.27
United States	**-28.36**	**43.29**	**-35.55**	**28.91**

Note: The percent change in tax revenue is percent difference in proposed-law tax revenue with respect to current-law tax revenue by country. The percent change in affiliate's reported profits is the percent change in the difference in the sum of affiliates' reported profits revenue under proposed law with respect to affiliates' reported profits under current law.

There are three noteworthy findings in Table 9. First, every country, except the United States, experiences a decrease in aggregate reported firm revenue. In contrast, the U.S. experiences an increase in aggregate reported firm revenue as a result. Second, every country, including the U.S., experiences a decrease in CIT revenue. In the case of the U.S., this finding shows that the increase in the CIT tax base or aggregate reported firm revenue is not large enough to offset the effect of the 20 percent reduction in the U.S. CIT rate. For the other countries, the decrease in CIT revenues is proportional to the decrease in the country's CIT tax base as a result of the proposal because they do not change their current-law CIT rate. Third, and most importantly for the purposes at hand, the estimated effect of the proposed reform on the percent decrease in CIT revenues for the U.S. is 15 percentages points smaller using estimates obtained from the Enforcement 1 model relative to that based on the First-generation model. In sum, this exercise illustrates the practical importance of using a correctly specified model to estimate the effect on reported profits of CIT-rate differentials for tax policy analysis.

6. Conclusions

As globalization increases so has international tax competition among countries to attract foreign direct investment. The resulting CIT-rate differentials among countries is leading to BEPS as MNEs shift profits from affiliates located in high CIT-rate countries to affiliates located in low CIT rate countries to minimize their aggregate tax liabilities thus increasing their worldwide after-tax profits.

This paper seeks to gauge the effect of CIT-rate differentials among countries on BEPS. I improve upon the existing literature by accounting for whether countries actually enforce their transfer-pricing rules and when they have the incentive to do so because of the tax incentive facing domestic affiliates of MNEs. I report strong evidence that correctly specifying the model of reported profits in the manner prescribed in this paper has important implications for the correct choice of function form and a substantial effect on the estimated semi-elasticities of reported profits. The main results are the following: the estimated semi-elasticity of BEPS is equal to -3.5, meaning that a 10% increase in the tax rate differential between countries results in a 35% decrease in reported earnings in the high tax country; when there is an increase in the incentive for outbound profit shifting, firms that are located in countries with strict anti-avoidance rules report 32% more profits than otherwise; when there is an increase in the incentive for inbound profit shifting, firms with ultimate owners located in countries with strict anti-avoidance rules report 10% less profits than otherwise.

I also conduct a policy simulation to illustrate the practical importance to tax policy analysis. I use my preferred estimates of the semi-elasticities of reported profits as well as an estimate of this semi-elasticity using a state-of-the-art but misspecified model to conduct the policy simulation. This exercise shows that using estimates of the semi-elasticities from a correctly specified model (that takes into account enforcement) has a substantial effect on the estimated tax revenue effect of the proposed reform.

Chapter II: Does Macroeconomic News Affect Monetary Policy Expectations and Asset Prices? Evidence from Event Studies

1. Introduction

Government authorities and investors were strongly impacted by the market loanable funds during the recent financial crisis. Since interest rates are prices of loanable funds, they play a crucial rule in moments of economic instability, like the 2008-2010 Great Recession. Interest rates are indirectly set by a country's central bank; they increase (decrease) when a central bank conducts contractionary (expansionary) open market operations in periods of economic expansion (recession).

The Federal Reserve is the central bank of the United States. It influences interest rates by setting the price that depositary institutions, such as banks, need to pay in order to borrow reserves overnight (known as the discount rate) and by determining the level of reserve requirements. Usually, depositary institutions prefer to trade excess reserves to met overnight reserve requirements among another because it is less expensive and because there is a stigma assisted with borrowing from the central bank (lender of last resort). In simpler terms, a depository institution with excess cash lends to another depositary institution that needs to quickly raise liquidity at a price called the federal fund rate, which is always lower than the discount rate.

The Federal Open Market Committee (FOMC) is the branch of the Federal Reserve that determines the federal fund rate target[9] that can be reached by deciding the level of reserve requirements and the discount rate. Indeed, the Federal Reserve indirectly sets the federal fund

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[9] This rate influences the effective federal funds rate through open market operations or by buying and selling of government bonds (government debt). More specifically, the Federal Reserve decreases liquidity by selling government bonds, thereby raising the federal funds rate because banks have less liquidity to trade with other banks. Similarly, the Federal Reserve can increase liquidity by buying government bonds, decreasing the federal funds rate because banks have excess liquidity for trade.

rate. Whether the Federal Reserve wants to conduct expansionary or contractionary open market operations depends on the state of the economy. If the FOMC believes the economy is growing too fast and inflationary pressures are consistent with the Federal Reserve's objective, the Committee may set a higher federal funds rate target to control economic activity. In the opposing scenario, the FOMC may set a lower federal funds rate target to stimulate the economy. Therefore, the FOMC must observe the current state of the economy to determine the best course of monetary policy that will maximize economic growth and achieve economic stability. The federal funds rate influences other interest rates such as the prime rate, which is the rate banks charge their customers for credit cards. Additionally, the federal funds rate indirectly influences long-term interest rates such as mortgages, loans, and savings, in order to promote consumer wealth and financial markets confidence.

As a consequence, a lot of research has been done in trying to understand the dynamics behind monetary policy expectations and investments decision-making is essential for a central bank and financial investors. By correctly predicting monetary policies, investors can build accurate asset pricing models and potentially increase their return on investments. From the perspective of the Federal Reserve, assessing the linkages between monetary policy expectations and investors' behavior is important in order to promote economic stability and reaffirm confidence in financial markets when needed. Given that the Federal Reserve adjusts its open market operation depending on the state of the economy, so should investors.

In this paper, I investigate the effect of macroeconomic news announcements on monetary policies expectations and ultimately on financial markets in the United States. I contribute to the existing literature by estimating the following: the effect of macroeconomic news surprises on short and long-term monetary policy expectations calculated using federal funds rates and LIBOR rates;[10] the effect of positive and negative macroeconomic news announcements on monetary policy expectations; the effect of changes in short and long-term monetary policy expectations on financial markets on days of macroeconomic news announcements compared to days of FOMC announcements. Differently from Gurkaynak, Sack, and Swanson (2004); Doh and Connelly (2013) and Berge and Cao (2014), I compute a factor analysis using federal funds futures and Eurodollar futures[11] collected not only on days of FOMC announcements, but also on days when other macroeconomic indicators are publically announcement. To be more specific, I extended the event study to days of non-farm payroll, initial job claims, gross domestic product (GDP), Institute for Supply Management (ISM) survey, Consumer Price Index (CPI),[12] consumer confidence index, University of Michigan consumer sentiment index, retail sales[13] and new home sales announcements. To simplify the terminology used in this paper, I refer to the above indicators as "macroeconomic indicators/news" announcements (to distinguish them from FOMC announcements). FOMC announcement days are considered any day when there is an FOMC meeting followed by a public testimony or a statement and days when the "minutes" comes out. These macroeconomic indicators are selected based on their Bloomberg relevance index, which identify financial markets most followed economic releases. The methodology used is a Newy-West event study on 2,387 announcement days from 1998 to 2016.

I conclude that short and long-term monetary policy expectations are affected by

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[10] LIBOR or ICE LIBOR (previously BBA LIBOR) is a benchmark rate that some of the world's leading banks charge each other for short-term loans. The market expectations of the LIBOR rate are inbounded in the Eurodollar futures.

[11] Eurodollar futures are time deposits denominated in U.S. dollars at banks outside the United States, and thus are not under the jurisdiction of the Federal Reserve. Eurodollar futures are based on the LIBOR rate that is a benchmark rate that some of the world's leading banks charge each other for short-term loans. This is also used as an estimate of bank lending costs.

[12] Month to month percentage change.

[13] Month to month percentage change.

unexpected changes in non-farm payroll, initial job claims, GDP, ISM, CPI, consumer confidence index, University of Michigan consumer sentiment index, retails sales and new home sales. Furthermore, I report evidence that financial investors expect interest rates to rise (fall) when there are positive[14] (negative) macroeconomic indicator announcements. Finally, the reaction of financial markets on changes in both short and long-term monetary policy expectations is larger in absolute value on days of macroeconomic indicator announcements compared to days of FOMC announcement. However, it is important to note that asset prices and volatility respond differently to news announcements (see results for details). Finally, I check for robustness by subsampling my event study to announcements made exclusively during the latest global financial crisis (December 2007-June 2010). In this latter case I observe that differently from long-term monetary policy expectations, short-term monetary policy expectations are not effected by macroeconomic news surprises, which occurs when the market over/under estimate the true value of a macroeconomic indicator.

The remainder of the paper is organized as follows. Section 2 provides a brief overview of the literature on the effect of FOMC announcements and macroeconomic indicator surprises on asset prices and volatility. Section 3 provides an outline on the variable construction, data and methodology. Section 4 describes the empirical analysis including the model, results and robustness checks. Section 5 concludes.

[14] News is considered to be positive (negative) when the realized value is higher (lower) than the market forecast, except for change in initial job claims when news is considered to be positive (negative) when the realized value is lower (higher) than the market forecast.

2. Literature review

This section begins with an overview of the literature on the effect of monetary policy expectations on financial markets followed by an overview of the literature on the effect of macroeconomic news surprises on financial markets.

The original literature suggests that changes in monetary policies are transferred to the stock market via changes in the cost of capital and private wealth (Bernanke & Kuttner, 2005). Indeed, it is not surprising that US stocks and bonds do react to changes in monetary policy expectations (Gurkaynak, Sack, & Swanson, 2004; Wongswan, 2009). For example, rising short-term interest rates in the U.S. result in a decline in stock market prices and in an upward shift of the yield curve (Rigobon & Sack, 2004). The impact that changes in monetary policies have on financial market mainly depends on financial market's current expectation of these policies, which are deducted by following FOMC announcements and looking at the state of the economy. Federal funds futures can be used to approximate investors' monetary policy expectation (Berge, 2012; Berge & Cao, 2014; Bernanke & Kuttner, 2005; Doh & Connolly, 2013; Gospodinov & Jamali, 2012, 2014; Gurkaynak et al., 2004; Hamilton, 1996; Robertson & Thornton, 1997). Hamilton (1996) is the first research to use federal funds rates to calculate short and long-term unexpected changes in monetary policy expectations (known as monetary policy surprises). He computes them by taking the difference between a federal funds future observed on days of FOMC announcements and its value before the announcement. Therefore, the estimated difference captures financial markets unexpected changes in monetary policies. When the difference is zero, it means that the financial markets have correctly predicted the Federal Reserve's action, so there are no surprises. When the difference is not zero, the financial markets were not able to anticipate the monetary policy currently. When the difference is calculated using a federal funds future that matures in the current month, this difference captures short-term monetary policy surprises. Differently from the short-run monetary policy expectations, the three-month federal fund future is used to capture long-term monetary policy surprises.

Gurkaynak, Sack, and Swanson (2004), henceforth GSS, improved upon the existing literature by showing that the effects of FOMC announcements on financial markets is not driven by a single factor (changes in the federal funds rate target), but two factors. GSS offer an alternative way to capture monetary policy expectations surprises by using both federal funds futures and LIBOR rates. By computing a factor analysis, GSS summarize changes in short-term and long-term monetary policy expectations with two factors: the target factor and path factors. These factors have a structural interpretation as a "current federal funds rate target" factor and a "future path of policy" factor.

The target and path factors estimated by GSS and the short and long term monetary policy surprises introduced by Hamilton (1996) are intermittently used to access the effect of monetary policy expectations on assets prices and market volatility. Overall, researchers have found that there is a negative relationship between long term unexpected changed changes of monetary policy (path factor) and asset prices, while there is a positive relationship between both the target and path factor and the yield of corporate/treasury bonds (Berge & Cao, 2014; Gospodinov & Jamali, 2014; Gurkaynak et al., 2004). According to GSS, one percentage point contraction in the accompanying FOMC statement leads to a decline of 4.3 percent in the return of the S&P500 as well as an increase of 47, 27 and 12 basis points in the yields of the two, five, ten-years treasury note, respectively. These results, even if small, match the theory, which suggest that there is an inverse relationship between bond prices and interest rates. On the other side, although the relationship between interest rates and the stock market is fairly indirect, it is difficult to predict in which direction to the stock market moves when there is a cut or increase in interest rates.

According to Doh & Connolly (2013) the signs and statistical significance of the effect of monetary policy expectations on financial markets are consistent before and after the latest recession, but not their magnitude. For instance, the elasticity of asset prices and bond yields to changes in monetary policy expectations are larger before the 2008-2009 financial crisis than during the crisis. This could be explain by the fact that investors anticipated that the recession was going to be long one and that the Federal Reserve was going to keep interest rates low for a very long time.

A great deal of work has also been done on the effect of macroeconomic news announcements on asset prices (Brenner, Pasquariello, & Subrahmanyam, 2009; Flannery & Protopapadakis, 2002; Gospodinov & Jamali, 2012; Hardouvelis, 1987; Kim, McKenzie, & Faff, 2004; Scotti, 2013). Scotti (2013) shows that the surprise indexes are a parsimonious summary measure of the state of the economy and its business cycle.[15] Gospodinov & Jamali (2012) use changes in non-farm employment, consumer confidence and industrial production as a robustness check. They conclude that the implied volatility of the S&P500 no longer exhibits a larger response to monetary policy surprises relative to its realized volatility when these indicators are added into their model. Gilbert, Scotti, Strasser, & Vega (2010) conclude that macroeconomic indicators announcements do not have the same effect on all asset prices. Flannery at al. (2001) demonstrate that stock market returns are significantly correlated with inflation and money growth. They estimate a GARCH model of daily equity returns, where

[15] For example, if the unemployment rate is low it shows that the economy is performing well. When the unemployment becomes suddenly high it is considered a negative surprise. If this indicator keeps staying negative it might suggest that an anticipated recession is coming. Eventually market predictions of unemployment rate will adjust to he “new low values”.

realized returns and their conditional volatility depend on 17 macro series announcements.

While a lot of research has been done on the effect of monetary policy expectations and macroeconomic news surprises on financial markets, very little has been done on the effect of macroeconomic news surprises on monetary policy expectations. Someone might argue that there is a simultaneous causality between macroeconomic news surprises and monetary policy expectations: monetary policies influence the state of the economy and investors expectations of macroeconomic news, but at the same time macroeconomic news influence the Federal Reserve's monetary policy decision making (as argued in the introduction of this paper). In reality, the chances that investors forecast short- and long-term macroeconomic indicators based on the current monetary policy decision are very low since no one can correctly predict how long it takes for a monetary stimulus to affect the real economy. This paper aims to fill the gaps between the literatures described above by first estimating the effect of macroeconomic news surprises on monetary policy expectation, and secondly by testing whether or not financial markets react strongly to changes in monetary policy expectations on days of macroeconomic news announcements compared to days of FOMC announcements.

3. Variable construction, data and methodology

This section describes in details the methodology used to calculate the target and path factors as well as macroeconomic indicator surprises. Here, I also summarized the data used in the empirical portion of the paper and their origin.

3.1. Target and path factors

As previously discussed, monetary policy expectations can be measured using federal funds futures since they are excellent predictors of the federal funds rates (Hamilton, 2001). A federal funds future can be viewed as the expected average price for federal funds in a particular contract month (Robertson & Thornton, 1997).[16] Following Hamilton (1996), in this paper short-term monetary policy surprises are calculated by subtracting the value of the current month federal funds future before the release of a macroeconomic indictor or FOMC announcement to its values on the announcement day, scaled by the remaining days to maturity, as the following:[17]

$$\Delta i^{u,0} = \frac{D}{D-d}\left(f_{m,d}^{0} - f_{m,d-1}^{0}\right) \tag{1}$$

$\Delta i^{u,0}$ is the monetary policy unexpected surprise of a federal funds future that expires in the current month (zero means zero months ahead, so the current month); $f_{m,d}^{0}$ is the federal funds future observed on day, d, of month, m, that expires in the current month; $f_{m,d-1}^{0}$ is the federal funds future observed on day, d, of month, m, that expires in the current month; d is the day of a month when a monetary policy announcement is made, D is the total number of days in a month, m. Similarly, to (1), equation (2) denotes long-term monetary policy surprises. These are calculated by taking the difference between the expected federal funds future on the day when a macroeconomic news or FOMC meeting is observed and its value the day before the announcement, scaled by the remaining days to the next announcement, and by subtracting the short-term surprise calculated in equation (1), as the following:

$$\Delta i^{u,n} = \frac{D_n}{D_{n-d_n}}\left[\left(f_{md}^{n} - f_{m,d-1}^{n}\right) - \frac{d_n}{D_n}\,\Delta i^{u,0}\right] \text{ for n=1,..10} \tag{2}$$

$\Delta i^{u,n}$ is the monetary policy surprise of a federal fund future that expires on month, n; d_n and D_n are the day of the next news announcement (both FOMC and macroeconomic news) and the number of days in the month containing the next announcement, respectively.

In order to capture the monetary policy expectation embodied in the Eurodollar futures I first need to subtract the value of the Eurodollar from 100 to isolate the LIBOR rate (L). Second, I compute the following equation:

[16] The future value of the federal fund rate is calculated by subtracting the contract price of the future from one hundred.

[17] If the event happened within the last seven days of a month I will use the following month future value to compute the shock.

$$\Delta L^{\propto} = L^{\propto}_{md} - L^{\propto}_{m,d-1} \qquad \text{for } \alpha=1, .., 10 \qquad (3)$$

Here $L^{\propto}_{md}$ is the value of the 3-month LIBOR rate at day, d, and month, m; $L^{\propto}_{m,d-1}$ is the value of the LIBOR rate before the macroeconomic announcement or FOMC meeting/minute realized; $\propto$ is the quarter when the Eurodollar future matures.

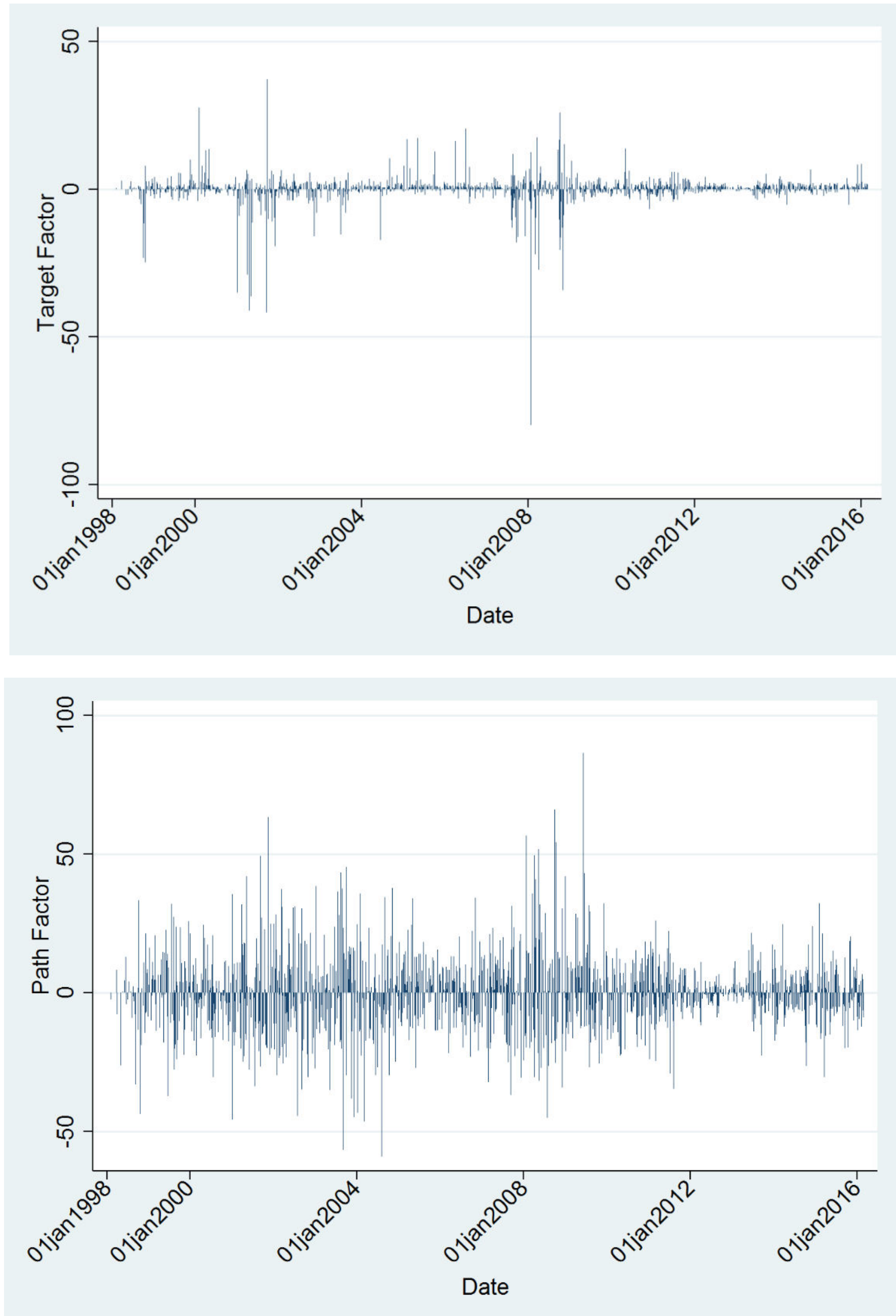
In this paper, I use federal funds futures that expire at different maturities starting from the current month to ten months ahead and Eurodollar futures that expire at different maturities starting from the current quarter to ten quarters ahead. After calculating equations (1), (2) and (3) on the eleven federal funds futures and eleven LIBOR rate on 2,310 announcement days, I finally compute a factor analysis.[18]

As previously anticipated by GSS, I obtain two factors that summarize 88 percent[19] of all variations in the monetary policy surprises calculated using equations (1), (2) and (3). These factors are known as the target factor (short-term monetary policies expectations) and the path factor (long-term monetary policies changes expectations). Figure 2 portrays values of path and target factors from 1998 to 2016.

[18] Details on the methodology used to compute the factor analysis are summarized in details by Doh & Connolly (2013).

[19] This number is calculated based on the factor loadings of each variable after the orthogonal rotation. Results are available upon request.

Figure 2. Target (short-term monetary policy expectations) and path factors (long-term monetary policy expectations) from 1998 to 2016



Note: Author's calculations. Values are expressed in basis points.

According to Figure 2, since 2009 the target factor has been close to zero, while the path factor has been more volatile. This implies that financial markets do not change their short-term monetary policy beliefs as often as their long-term beliefs. Table 10 shows the top five largest positive and negative changes in the target and path factors and their corresponding macroeconomic events.

Table 10: Largest movements of the path and target factors

Largest movements of the Target Factor			
Date	Target	Path	Macroeconomic release
22-Jan-08	-79.97	-19.62	FOMC
18-Sep-01	-41.71	27.22	CPI
18-Apr-01	-41.11	-16.86	FOMC
20-Sep-01	37.28	-14.95	Initial Job Claims
3-Jen-01	-35.00	35.55	FOMC
Largest movements of the Path Factor			
Date	Target	Path	Macroeconomic release
5-Jun-09	0.18	86.42	Change in Non-Farm Payroll
29-Sep-08	16.62	66.02	FOMC
6-Aug-04	-2.03	-58.92	Change in Non-Farm Payroll
24-Jan-08	12.44	56.75	Initial Job Claims
05-Sep-03	5.64	-56.52	Change in Non-Farm Payroll

Source: Author's calculations, Bloomberg Calendar.

According to Table 10, several outliers of both the target and the path factor are observed on days when macroeconomic indicators are announced instead of days of FOMC announcements. The top ten outliers listed in Table 10, correspond to the following economic news reported by the New York Times, CNN Money or Federal Reserve Board of Governor:

- April 18th, 2001: the U.S. stocks rallied after the Federal Reserve rocked Wall Street with a surprise interest rate cut, lifting hopes that corporate profits will recover sooner than expected.
- January 22nd, 2008: Federal Reserve makes the biggest Federal fund rate cut in nearly 24 years.
- September 18th, 2001: this day was the first trading day after the September 11 attacks. Plus, on September 17th, the Federal Reserve lowered the target rate of 50 basis points on September 17th, 2001.
- September 20th, 2001: jobless claims tumbled to 387,000 well below Wall Street forecasts of 420,000. However, this day is well known as President Bush declaration of "War on Terror" after the terrorist attack of September 11th, 2011.
- January 3rd, 2001: the Federal Reserve Chairman Alan Greenspan announced a surprise interest rate cut.
- June 5th, 2009: CNN Money reported "annual loss biggest since the end of World War II. Unemployment rate rises to 7.2 percent".
- September 29th, 2008: The Federal Reserve dropped the target rate to 1 percent as the pace of economic activity appears to have slowed remarkably.
- August 6th, 2004: the job growth was weaker than the market expected.
- January 24th, 2008: the $150 billion stimulus approved by the Bush administration account its first difficulties.
- September 5th, 2003: CNN money reports that defying private economists' forecasts for an increase and highlighting fears that the labor market could be slow to catch up to

stronger growth in the rest of the economy.

3.2. Macroeconomic indicators surprises

The macroeconomic indicators used in this paper have been selected based on their Bloomberg relevance index.[20] The latter identify the major macroeconomic indicators that investors rigorously follow on Bloomberg. The Bloomberg relevance index for FOMC meetings is currently 97.2, making it the third most relevant news to investors after changes in non-farm payroll and job claims. The surprise index for each of the macroeconomic indicators listed in Table 11[21] is calculated as the following:

$$I_t^i = \frac{y_t^i - \mathrm{m}[y_t^i|\mathcal{F}_i]}{\sigma_i} \tag{4}$$

Here, i represents one of the nine indicators listed in Table 12; t is the day when indicator i was publically announced; I_t^i is the normalized surprise index of indicator i at time t; y_t^i is the actual value of a macroeconomic indicators; $\mathrm{m}\left[y_t^i|\mathcal{F}_i\right]$ is the median Bloomberg forecast of indicator i; andσ_i is the standard deviation of the forecasts of indicator i. Each indicator is normalized to allow comparison between each other. I also create a dummy variable that is equal to one when a macroeconomic surprise is positive and zero otherwise[22]:

$$\boldsymbol{\vartheta_i} = \begin{cases} \mathbf{= 1\ if\ I_t^i > 0} \\ \mathbf{= 0\ if\ I_t^i < 0} \end{cases}$$

Where ϑ_i is a dummy variable for negative (=0) or positive(=1) news.

[20] The Bloomberg relevance is a number between zero to one hundred: zero meaning that investors never look at a specific indictor when it comes out, one hundred meaning that investors always look at a specific indicators when it comes out. It is based on the number of clicks on Bloomberg at the moment of the news release.
21 MBA Mortgage Applications is also a highly observed by financial markets but Bloomberg does not keep truck of its forecast standard deviation making impossible to normalize the surprise component of this index. Indeed, this index is excluded from the empirical analysis
[22] Expect for changes in initial job claims that are equal to one if less than zero and zero otherwise.

Table 11: List of macroeconomic indicators and their Bloomberg relevance index

Indexes	
Indicators	Relevance Index
Change In Non-Farm Payroll (NP)	99.2%
Initial Job Claims (JL)	98.4%
GDP (GDP)	96.8%
ISM (IMS)	95.9%
CPI MoM (CPI)	95.2%
Consumer Confidence Index (CCI)	94.4%
U. Michigan Consumer Confidence Index (UM)	93.6%
Retails Sales MoM (RS)	91.9%
New Home Sales (NSH)	90.3%

3.3. Data

Data on federal funds futures, Eurodollar futures, macroeconomic news forecast, S&P500 closing price and the VIX are collected from Bloomberg. Daily data on the yield curve are downloaded from the U.S. Department of Treasury. The lists of days when a macroeconomic indictor is released to the public or there is a FOMC announcement are collected from Bloomberg and the Board of Governors. The summary statistics of all variables are available in Table 12.

Table 12: Summary Statistics

Variable	Mean	Std.Dev.	Min	Max
Target factor	0.104	3.910	-46.63	27.62
Path factor	0.0154	15.70	-54.88	72.32
Returns of the S&P 500	0.0601	1.260	-9.035	10.79
Three-months treasury bill	-0.507	4.823	-52	46.00
One-year treasury note	-0.386	4.316	-50	22
Ten-years treasury note	0.00216	6.351	-28.00	24.00
VIX	-9.025	166.6	-1310	1412
Dummy variable for good news	0.310	0.463	0	1
Change in Non-Farm Payroll Surprise	-0.0424	0.727	-8.190	6.350
GDP surprise	-0.0115	0.557	-5.670	5.900
New Home Sales Surprise	-0.000909	0.925	-8	8.860
Retail Sales Surprise	-0.0102	0.536	-5.220	7.070
Initial Job Claims Surprise	0.00118	1.633	-27.58	12.55
Consumer Confidence Surprise	-0.0150	0.908	-9.070	7.980
University of Michigan Consumers Confidence Index Surprise	-0.0445	1.009	-9.530	8.660
ISM Surprise	-0.00497	0.709	-11.85	6.380
CPI Surprise	-0.0117	0.415	-4.130	3.950

Note: The total number of events is 2,387.

4. Empirical estimation

4.1. Econometric model

The methodology used is a Newey-West event study on a predefined window of one day between January 1998 and March 2016. The events included in this study are associated with the public release of the nine indicators listed in Table 11 and FOMC announcements.

First, in order to investigate the effect of macroeconomic indicators announcements on monetary policies expectations I estimate the following equation:

$$M_{m,d} = \alpha + \sum_{j=1}^{9} \beta_j X_{m,d} + \epsilon_t \quad (5)$$

$M_{m,d}$ is the target or the path factor calculated on day d and month m as explained in section 3.1; β_j depends on news j (=1, ..,9); $X_{m,d}$ is a vector of macro news surprises calculated on day d and month m as explained in section 3.2.

Second, in order to investigate the effect of positive and negative news announcements on monetary policies expectations I estimate the following equation:

$$M_{m,d} = \alpha + \beta_j \delta_{m,d} + \epsilon_t \quad (6)$$

Where $\delta_{m,d}$ is a dummy variable equal to one if a news is positive and zero otherwise.

Finally, I look at the effect of monetary policy expectations on financial markets when macroeconomic news are released compared to days of FOMC announcements using the following equation:

$$y_{m,d} = \alpha + \alpha_1 Path + \alpha_2 Target + \sum_{n=1}^{9} \beta_n^i \eta_i + \sum_{k=10}^{18} \beta_k^i Path * \eta_i + \sum_{q=18}^{27} \beta_q^i Target * \eta_i + \epsilon_t \quad (7)$$

Here, η_i is a dummy variable equal to one on the day when a macroeconomic indicator i is observed and 0 otherwise; i corresponds to following indicators: non-farm payroll, initial job claims, GDP, ISM, CPI, consumer confidence index, University of Michigan consumer sentiment index, retails sales and new home sales; $\beta_k^j(\beta_q^j)$ identifies whether or not long-term (short-term) monetary policy expectations have a larger or smaller effect on financial markets on days of a macroeconomic news announcement compared to days of FOMC announcements. In equation (7), the base group corresponds to days of FOMC announcements and their interaction terms with target and path factors.

4.2. Results

Table 13 reports the estimates of equations (5) and (6). Table 14 shows the results obtained after estimating equation (7). According to Table 13, macroeconomic news surprises do effect monetary policy expectations. Surprises in macroeconomic news announcements have a larger effect on long-term monetary policy expectations (Table 13 column 2) than short ones (Table 13 column 3). As visible in Table 13 column 2, the elasticity of long-term monetary policy expectations to changes in non-farm payroll, retails sales, initial job claims, the University of Michigan consumer sentiment, the ISM, GDP and CPI are statistically significant at the conventional level of significance. As expected all variables have a positive sign except for job claims. If initial job claims are higher than expected, financial markets believe that interest rates should consequently decrease.

According to Table 13 column 3, even if the coefficients of non-farm payroll, GDP, CPI, consumer confidence and new home sales surprises are positive and statistically significant at the conventional level of significance, their effects on short-term monetary policy expectations (target factor) are quite small. For instance, if the surprise index of changes in non-farm payroll increases by one standard deviation, short-term monetary policy expectations rise by only 0.37 basis points after the increase. These results suggest that when macroeconomic news indicators are greater than financial markets have previously forecasted, investors believe that interest rates should soon rise as the economy stabilizes.

Finally, positive (negative) news has a positive (negative) effect on both long- and short-term monetary policy expectations as visible in Table 13 columns 4 and 5, respectively. When news is positive (negative), investors expect the Federal Reserve to increase (decrease) federal funds rates in the short and long-term via expansionary (contractionary) open market operations. The elasticity of macroeconomic news surprises on monetary policy expectations are larger in absolute value for the path factor compared to the target one. These results suggest that long-term monetary policy expectations are more sensitive to unexpected changes of macroeconomic indicators than short-term monetary policy expectations.

Table 13: The effect of macroeconomic indicator surprises on monetary policy expectations

	Factors			
Variables	Path	Target	Path	Target
Change in non-farm payroll surprise	4.913***	0.372*		
	(0.725)	(0.219)		
Initial job Claims surprise	-0.981***	-0.0378		
	(0.283)	(0.0396)		
GDP surprise	1.145**	0.154*		
	(0.582)	(0.0883)		
ISM surprise	2.766***	0.0827		
	(0.602)	(0.339)		
CPI surprise	1.605*	0.297*		
	(0.870)	(0.170)		
Consumer confidence index surprise	0.419	0.0830**		
	(0.343)	(0.0393)		
University of Michigan consumer sentiment index surprise	0.647**	0.0348		
	(0.283)	(0.0433)		
Retail sales surprise	2.681***	0.0304		
	(0.549)	(0.0494)		
New home sales surprise	0.406	0.0442*		
	(0.349)	(0.0264)		
Positive News			5.638***	0.374*
			(0.697)	(0.214)
Constant	0.249	0.0724	-2.766***	-0.130
	(0.329)	(0.0998)	(0.470)	(0.141)
Observations	2,387	2,387	2,387	2,387

Note: The path factor represents long-term monetary policy expectations; the target factor represents short-term monetary policy expectations.

Table 14 displays the elasticity of the return of the S&P500, [23] the VIX, the three-months bill, one- and ten-years Treasury note to changes in the target and path factors as indicated in equation (7). According to Table 14 Colum 2, changes in the target (path) factor have a negative (positive) effect on the returns of the S&P500 on days of FOMC announcements. The response of the return of the S&P500 to changes in long-term monetary policy expectations (path factor) on days of ISM is greater and statistically significant at the conventional level of significance compared to days of FOMC announcements. Similarly, the return of the S&P500 is greater in absolute value when there are changes in short-term monetary policy expectations and statistically significant at the conventional level of significance on days of non-farm payroll compared to days of FOMC announcements.

On the other side, the VIX is not affected by changes in long-term monetary policy expectations, but only by short ones (Table 14 Colum 3). The VIX is more affected (absolute value) on days of non-farm payroll, GDP and CPI compared to days of FOMC announcement. On the contrary, the effect of changes in the target factor on the VIX on days when the University of Michigan consumer sentiment index is announced is smaller in absolute value compared to days of FOMC announcements. For instance, if the target factor increases by 25 basis points, the VIX is 113 basis points lower on days when the University of Michigan consumer sentiment index is announced compared to the base group.

Focusing now our attention to the Treasury yield curve, an increase in the target factor has a positive effect on the three month, one- and ten-years treasury notes as reported in Table 5 column 4, 5, 6 respectively. Oppositely, changes in the path factor affect only the ten-years Treasury note. An increase in the target factor on days of changes in job-market claims have a

[23] The returns of the S&P500 are calculated as the following: $r = In_{(p+1)} - In_{(p)}$ where r is the rate of return and P is the closing price of the day before the event was announced.

larger positive effect on the three-months Treasury bill compared to FOMC announcements. Changes in the target factor on days of ISM releases have a negative effect on the three-months Treasury bill compared to the same movement of the target factor on days of FOMC announcements. Similarly, changes in the target factor on days of initial job claims, retail sales and new home sales have a larger effect in, absolute value, on the one-year Treasury note compared to days of FOMC announcement. The ten-years bond is positively (negatively) affected by changes in the target factor on days of ISM (non-farm payroll, consumer confidence index and retail sales) announcement compared to days of FOMC announcements. The difference in signs, coefficient magnitudes and statistical significances depends on the importance that investors give to macroeconomic news release and how they effect their monetary policy expectations. The results discussed above signal that investors do change their monetary policy expectations on days when other macroeconomic indicators come out, and not only on days of FOMC. It also shows that the effect of these changes on financial markets is pronounced on days when several macroeconomic indicators come out compared to days of FOMC announcements. The latter suggests that financial markets do follow macroeconomic indicators and set their monetary policy expectations based on their forecast of the economy; when these forecast are not met, financial markets strongly react.

Table 14: The Effect of monetary policy expectations on financial markets on days of macroeconomic indicators announcements compared to FOMC announcement

Variables	S&P500	VIX	3 Month Note	One-year Bill	Ten-years Bond
Path	0.019**	-2.203*	0.033	0.166***	0.333***
	(0.008)	(1.187)	(0.029)	(0.014)	(0.016)
Target	-0.011	-3.963	0.651***	0.531***	-0.103*
	(0.026)	(2.871)	(0.158)	(0.092)	(0.063)
Change In Non-Farm Payroll (NP)	-0.048	-22.580*	0.545*	0.014	-0.283
	(0.103)	(13.390)	(0.319)	(0.228)	(0.351)
Initial Job Claims (JL)	-0.076	13.380	-0.210	-0.281*	-0.616***
	(0.069)	(9.515)	(0.252)	(0.169)	(0.204)
GDP (GDP)	0.030	-21.400*	-0.037	0.049	-0.380
	(0.088)	(11.840)	(0.278)	(0.179)	(0.272)
ISM (IMS)	0.015	19.070	1.301***	0.533**	-0.093
	(0.102)	(14.310)	(0.418)	(0.249)	(0.307)
CPI MoM (CPI)	-0.075	-5.500	-0.673**	-0.222	-0.398
	(0.103)	(13.870)	(0.316)	(0.201)	(0.313)
Consumer Confidence Index (CCI)	0.024	-10.970	0.107	0.010	-0.300
	(0.152)	(19.160)	(0.312)	(0.217)	(0.269)
U. Michigan Consumer Confidence Index (UM)	-0.110	6.635	0.338	0.016	-0.720***
	(0.077)	(10.060)	(0.310)	(0.223)	(0.236)
Retails Sales MoM (RS)	-0.125	22.930	-0.345	0.018	0.388
	(0.121)	(17.430)	(0.251)	(0.154)	(0.348)
New Home Sales (NSH)	0.006	-5.565	0.646*	0.106	0.018
	(0.096)	(11.320)	(0.373)	(0.206)	(0.253)
NP×Path	-0.008	0.874	0.019	0.003	-0.049**

	(0.009)	(1.162)	(0.032)	(0.020)	(0.022)
NP×Targer	-0.048*	6.816***	0.075	0.087	-0.175**
	(0.027)	(2.482)	(0.187)	(0.138)	(0.077)
JL×Path	0.001	0.099	0.026	0.026	0.002
	(0.008)	(0.997)	(0.030)	(0.018)	(0.017)
JL×Targer	0.030	-2.365	0.231*	0.171*	0.0277
	(0.025)	(3.299)	(0.129)	(0.088)	(0.064)
GDP×Path	-0.009	0.703	-0.019	-0.025	0.0172
	(0.007)	(1.064)	(0.019)	(0.020)	(0.020)
GDP×Targer	-0.087*	21.040**	0.035	-0.001	-0.230
	(0.049)	(9.249)	(0.314)	(0.158)	(0.155)
ISM×Path	0.017*	-2.334	0.039	0.032	0.016
	(0.010)	(1.435)	(0.034)	(0.022)	(0.023)
ISM×Targer	0.024	2.392	-0.529***	-0.390***	0.344***
	(0.025)	(3.127)	(0.153)	(0.094)	(0.064)
CPI×Path	-0.011	0.389	0.009	-0.014	0.003
	(0.010)	(1.127)	(0.037)	(0.024)	(0.039)
CCI×Path	0.017	-2.828	0.0167	-0.011	0.037
	(0.014)	(1.912)	(0.029)	(0.023)	(0.023)
CCI×Targer	-0.044	17.350	-0.410	-0.020	-0.230*
	(0.170)	(21.300)	(0.282)	(0.144)	(0.139)
UM×Path	-0.001	0.371	0.027	0.034	0.017
	(0.007)	(0.833)	(0.033)	(0.025)	(0.018)
UM×Targer	0.037	-4.536*	-0.277	-0.121	0.116
	(0.025)	(2.383)	(0.209)	(0.159)	(0.081)
RS×Path	0.005	0.248	0.022	-0.00537	-0.001
	(0.010)	(1.379)	(0.027)	(0.015)	(0.024)
RS×Targer	0.113	-12.560	0.482	0.350*	-0.896**

	(0.135)	(17.850)	(0.402)	(0.188)	(0.368)
NSH×Path	-0.006	0.418	0.067	0.007	0.015
	(0.009)	(1.022)	(0.041)	(0.021)	(0.020)
NSH×Targer	0.030	5.109	-0.489	0.561**	-0.315
	(0.103)	(9.183)	(0.577)	(0.262)	(0.238)
Constant	0.115	-12.820	-0.638***	-0.369**	0.476**
	(0.070)	(9.385)	(0.230)	(0.149)	(0.197)
Observations	2,387	2,387	2,387	2,387	2,387

Note: Newey-West (1987) Heteroskedasticity and Autocorrelation Constant Standard errors in parenthesis (HAC, 3 lags). Results expressed in percentage for the S&P500 and in basis points for everything else.

Table 17 in the Appendix displays the sum of the coefficients α_1 and β_k^j , and α_2 and β_q^j along with their joint test of statistical significance. The sum of α_1 and β_k^j (of α_2 and β_q^j) indicates the effect of changes in the path factor (target factor) on the return of the S&P500, VIX, three-months treasury bill, one-year treasury note and the ten-years treasury note for nine macroeconomic news releases and FOMC announcements.

Changes in the path and target factors have a positive effect on all dependent variables except the VIX. This suggests that changes in short-term monetary policy expectations have a negative effect on the volatility of the S&P500 independently on the announcement. For example, if the target factor increases by 25 basis points on days when the latest values of the ISM index are released to the public, the VIX is expected to increase by 598 basis points.

On the contrary, changes in short-term monetary policy expectations have a positive effect on the three-months Treasury bill and one-year Treasury note while it has diversified effects on the return of the S&P500, the VIX and the ten-years Treasury bond. For instance, one basis point change in the target factor on days of GDP announcements is expected to decrease the return S&P500 by 5.9 percent. Once again these later results suggest that when macroeconomic forecast are not met, investors change their short and long term monetary policy expectations, which untimely effect financial markets. These macroeconomic indicators are extremely important and often capable of shaking the stock and bond markets more than direct announcements on interest rates by Federal Reserve announcements.

4.3. Global recession

In this section, I subsample the event studies to announcements made during the latest global financial crisis (December 2007-June 2009) as a robustness check. Just like Table 13, Table 15 reports the estimates of equations (5) and (6), but only for the events that happened during the latest financial crisis. According to the results, short-term monetary policy expectations, the target factor (columns 3 and 5, Table 15), are not affected by macroeconomic news surprises, while long-term monetary policy expectations, the path factors (columns 2 and 4, Table 15) are affected by unexpected released values of non-farm payroll, initial job claims, GDP, ISM and retail sales. This makes sense since short-term expectations of monetary policies and the state of the economy have not changed in the short run over this period of time. In order words, during the latest financial crisis financial markets were able to anticipate the short-term spam of the recession. On the other side, the end of the recession was uncertain. Indeed, changes in macroeconomic indicators (even if small) had a large effect on long-term expectations of monetary policies (path factor), but not on the short one (target factor).

Table 15. The effect of macroeconomic indicator surprises on monetary policy expectations during the latest global financial crisis

	Factors			
Variables	Path	Target	Path	Target
Change in non-farm Payroll Surprise	4.359***	0.553		
	(1.112)	(0.533)		
Initial job Claims surprise	-1.257***	-0.0155		
	(0.265)	(0.0363)		
GDP surprise	1.283**	0.225		
	(0.526)	(0.166)		
ISM surprise	1.860***	-0.445		
	(0.615)	(0.557)		
CPI surprise	2.027	0.336		
	(1.384)	(0.243)		
C.C.I. ** surprise	0.133	0.0563		
	(0.371)	(0.0475)		
University of Michigan consumer sentiment index surprise	0.599*	0.0457		
	(0.335)	(0.0534)		
Retail sales surprise	2.469***	-0.0798		
	(0.555)	(0.0670)		
New home sales surprise	-0.112	0.0157		
	(0.406)	(0.0222)		
Positive News			4.716***	-0.164
			(0.949)	(0.265)
Constant	0.330	-0.0300	-2.101***	0.0318
	(0.414)	(0.124)	(0.631)	(0.153)

Note: The path factor represents long-term monetary policy expectations; the target factor represents short-term monetary policy expectations. The event window is from December 2007 to June 2009. ** Consumer Confidence Index . 1,154 Total observations

Estimates in Table 18 in the Appendix are very similar to the one reported in Table 17 in the Appendix. Changes in the path factor, when statistically significant at the conventional level of significance, have a positive effect on the return of the S&P500, the three-month Treasury bill, the one-year Treasury note and the ten-years Treasury note, independently on the announcement. On the contrary, changes in the target factor have a negative effect on the return of the S&P500 and the ten-years treasury note (except for days when the ISM was announced), while it has a positive effect on the VIX, three-months treasury note and the one-year treasury bill. Overall, Changes in the path and target factor on all dependent variables are very small. Once again these results underline the importance of macroeconomic announcements and suggest that even during the latest recession financial markets were changing their monetary policy expectations based on the state of the economy. It is not surprising that changes in long term expectations had a larger effect on financial markets because of investor's uncertainty.

5. Conclusions

In this paper, similar to Gurkaynak, Sack, and Swanson (2004), I compute a principle component analysis using federal funds futures and the LIBOR to capture short and long-run financial markets' monetary policy expectations in the United States. Differently from the current literature I use data on federal funds futures and eurodollar futures collected not only on days of FOMC meeting but also on days when other macroeconomic indicators are announced (namely change in non-farm payroll, initial job claims, GDP, ISM, CPI, consumer confidence index, University of Michigan consumer sentiment index, retails sales and new home sales).

These macroeconomic indicators are selected based on their Bloomberg relevance index, which identify investors most followed announcements on Bloomberg.

Finally, after computing an event study I make three important contributions to the current literature: first, monetary policy expectations are affected by unexpected values of non-farm payroll, initial job claims, GDP, ISM, CPI, consumer confidence index, University of Michigan consumer sentiment index, retails sales and new home sale; second, interest rates are expected to rise (fall) as a consequence of positive (negative) macroeconomic indicators and FOMC announcements; third, financial markets not only react to changes of short- and long-term monetary policy expectations on days of FOMC meetings, but also on days when other macroeconomic news are publically announced.

These results suggest that investors adjust their monetary policy expectations based on the state of the economy and that financial markets are vulnerable to surprises in macroeconomic news as well as FOMC announcements. These results emphasize the importance of a transparent and well thought communication between the Federal Reserve and financial investors in order to promote stability and stimulate investments.

Chapter III: The Impact of China's Economic Slowdown and United States' New Trade Policy on both the United States and China

1. Introduction

International trade and globalization are shaping the face of a new global economy and redirecting the stream of cash flow to low cost production countries. In the past decades, China has become the heart of the global economy, importing and exporting a large range of products to and from the world. Therefore, governments and in particular financial markets around the globe strongly react when China shows signs of economic slowdown (e.g. August 2015 and January 2016).[24] Given the exposure of China to other global economies, it is not surprising that policy institutions worldwide are constantly monitoring its economic development.

According to Zilio (2016), China is a major U.S. trading partner (by far the United States' largest source of imported goods as well as an increasingly important destination for U.S.-made products). The United States' other large trading partners have over the years also become more and more reliant on China's economy. For this reason, United States' investors and policy makers are concerned about China's economic performance and its possible effect on the United States economy. According to the World Bank and the OECD data, China economic growth (year over year) has been slowing down over the decades. [25] A slowdown in China's economic activity could strongly affect international trade and deliver a negative shock to the United States. Additionally, upcoming trade reforms in the United States (e.g. the border-adjustment tax) could have a strong impact on the trade dynamics between China and the United States.

[24] Financial markets around the globe reacted strongly in August 2015, when China started showing signs of economic slowdown. Financial markets weakened again in January 2016, when Chinese stocks fell dramatically after further devaluation of the Yuan.
[25] Going from its highest growth rate of 6.4 percent in 1965 to its lowest (-1.7 percent) in 2009, during the global financial crisis, to finally settle between 2-3 percent growth rate since 2011.

Clearly, trade is not the only channel through which China's slowdown could hold back economic growth in the U.S. A number of other dynamic mechanisms (including financial market volatility, consumer and business confidence, and exchange rates) might also affect American growth. This is why dynamic general equilibrium models are a better fit to attempt to explain the behavior of supply, demand, and prices in a whole economy with several or many interacting markets.

In this paper I investigate the effects of a negative productivity shock in China and two simultaneous trade shocks in the United States and China using a stochastic general equilibrium model previously introduced by Ghironi & Melitz (2005). [26]

In general, stochastic growth models for closed and open economies account for the magnitude of fluctuations, relative to output, in consumption and investment and the correlations of these fluctuations with output. In the Ghironi & Melitz (2005) model, in open economies, like the United Sates, their demand and supply are not only affected by their internal production. This also means that risks and shocks are shared across countries (both consumption risk and investment risk). The vast majority of international macroeconomic models take the pattern of international trade and the structure of markets for goods and factors of production as given. The determinants of such trade patterns are analyzed within methodologically distinct models that are generally limited to comparisons of long-run positions or growth dynamics after changes in trade's determinants. Ghironi & Melitz (2005) model fully address this weakness by including the determinants and evolution of trade patterns in their model. In this case, firms face sunk entry cost and uncertainty when making an irreversible decision to enter the domestic market. Firm's productivity and costs change over time, but only a small group of firms serve the international

[26] DSGE models study how the economy evolves over time. They are called stochastic when they take into account the fact that the economy is affected by random shocks such as technological change and price fluctuations.

market (the most productive ones). Indeed, this microeconomic structure endogenously determines the production and consumption of each country and it is affected by exogenous shocks to aggregate productivity, entry and trade.

This paper proceeds as follows. Section 2 looks at the literature review on both static and stochastic equilibrium models. Section 3 discusses the motivation behind the selection of shocks used in this paper. Section 4 summarizes Ghironi & Melitz (2005) model including their equilibrium, steady state conditions and parameters. Section 5 discusses the impulse response functions. Finally, Section 6 concludes.

2. Literature review

In this section, I discuss the current literature on the static and dynamic effects of a country shock within and across its borders (focusing on the United States and China).

To the best of my knowledge, there are only a few studies that look at the effect of fast growing countries slowing down the global economy (Ben-David & Papell, 1998; Eichengreen, Park, & Shin, 2011; Fernald, Edison, & Loungani, 1999; Pritchett, 2000; Reddy & Minoiu, 2009). Ben-David and Papell (1998) examine a sample of 74 advanced and developing countries spanning the period 1950-1990 and look for statistically significant breaks in time series for GDP growth rates. They find that while most industrialized countries experienced postwar growth slowdowns in the early 1970s, the United States, Canada and the United Kingdom did not. Developing countries -in particular Latin American countries- tended to experience much more severe slowdowns which occurred nearly a decade after the developing countries. Using international data from 1957 to 2013, Eichengreen, Park, & Shin (2011) conclude that rapidly growing economies slow down significantly (the growth rate downshifts by at least 2 percentage points) when their per capita incomes reach around $17,000. Among their more provocative findings is that growth slowdowns are more likely in countries that maintain undervalued real exchange rates (as if countries with undervalued currencies have less incentive to move up the technological ladder out of unskilled-labor intensive, low-value-added sectors and thus find it more difficult to sustain rapid growth). Fernald, Edison, & Loungani (1999) assess the linkages between China and the rest of emerging Asia, arguing that the devaluation of the yen in 1994 contributed to the Asian financial crisis. The transmission of this shock took the following path: if China's exchange rate depreciates, Chinese exports become more competitive, exceeding the export rate of other Asian economies. This causes a reduction in capital inflows, which diminishes job creation and slows down the Chinese economy.

Pritchett (2000) examines cases of developing countries where growth is sustained for a period and then stagnates or collapses. He compares what happens to developed and developing countries. He concludes that volatility in growth is much greater in developing countries than in developed ones. In a similar study by Reddy and Miniou (2009), stagnation is found to be more prevalent in poor, conflict ridden, commodity-exporting countries than in developed countries.

The majority of the models described above are static and do not allow the researcher to fully control for intertemporal, cross-country shocks transmission. To solve this issue, over the past decade there has been remarkable progress precisely estimating dynamic models (mainly dynamic stochastic general equilibrium (DSGE) models).

Backus, Kehoe & Kydland (1992) extend the existing theory on economic growth to a competitive model of a world economy with a single homogeneous good and internationally immobile labor. They conclude that poor but quickly growing countries borrow less from richer, more slowly growing countries than the theory suggests. Ghironi & Melitz (2005) bridge the gap between international macroeconomics and trade theory using Melitz's (2003) model of trade with monopolistic competition and heterogeneous firms as the microeconomic underpinning of a two-country dynamic stochastic general equilibrium model of international trade. They provide an explanation of why more productive economies, or less regulated ones (phenomena that affect all firms in the economy) exhibit higher average prices relative to their trading partners (Harrod-Balassa- Samuelson effect). Furthermore, they show that, with fully flexible prices, deviations from production possibility frontier display substantial endogenous persistence in response to transitory aggregate shocks. The Ghironi & Melitz (2005) model is often used in the DSGE literature (Arkolakis, Costinot, & Rodríguez-Clare, 2012; Atkeson & Burstein, 2008; Backus et al., 1992; Eaton, Kortum, & Kramarz, 2011; Helpman & Itskhoki, 2010; Shapiro & Mandelman, 2016) because it closely matches several moments of U.S. and international business cycles.

Given the increasing attention that investors and policy makers are giving to China's development, DSGE models that focus solely on the Chinese economy have been increasing over time (Bin, 2008; Chen, Funke, & Paetz, 2012; Zhang, 2009). Bin (2008) builds a DSGE model with financial-accelerator for monetary policy analysis and applies the Bayesian technique to account for China's business cycle. Chen, Funke & Paets (2012) develops a New Keynesian DSGE model to capture China's unconventional monetary policy toolkit. They find that credit quotas are important as the interest-rate corridor distorts the efficient reactions of the economy. Zhang (2009) explores two monetary policy rules- the money supply (quantity) rule and interest rate (price) rule in his DSGE model specifically designed to reflect the Chinese economy. The empirical results seem to indicate that the price rule is likely to be more effective in managing the price than the quantity rule, favoring the government's intention of liberalizing interest rates and making more active use of the price instrument. According to Chen at al. (2012), China's monetary policy approach has three main features. First, the People's Bank of China (PBoC) regulates the policy rate, the retail lending rate and the deposit rate. Second, they use non-market tools such as loan quotas and window guidance to directly affect depositary institutions landing strategies. Third, they set the required reserve ratio. Considering that monetary policy instability may cause indeterminacy of the macroeconomic equilibrium, their paper derives the boundary condition between determinacy and indeterminacy in a small open economy DSGE model. They then use this model to investigate China's monetary policy and macroeconomic fluctuations under indeterminacy during the period from 1992 to 2011. The empirical results show that the nominal interest rate reacts not only to inflation and output gap, but also to the changes in their currency exchange rate. Moreover, the indeterminacy in the macro-dynamics indicates the instability in China's monetary policy stems from two sources- the sunspot shock and the indeterminate propagation of fundamental shocks. In addition, they find that the monetary policy shock affects macroeconomic dynamics significantly in the short run. While in the long run it only influences nominal variables, such as inflation and the exchange rate, but not the real output.

Since the aim of this paper is to shed light on the effect of China’s economic slowdown on the US economy, I use Ghironi & Melitz’s (2005) DSGE model. Their model is a stochastic general equilibrium two-country model of trade and macroeconomic dynamics. This paper differs from the literature because it specifically looks at the case of the United States and China. Because the results highlight the dynamic effect of two current and highly discussed policy issues in the United States (namely China’s economic growth slow down and the border-adjustment tax), this paper is particularly relevant to policy makers.

3. Motivation

China’s economic slowdown has been at the center of the attention of U.S. policymakers and investors, who are concerned about how China's economic performance could affect the United States economy. For example, in the minutes of its June 14–15, 2016 meeting, the Federal Open Market Committee stated, "continued uncertainty regarding the outlook for China's foreign exchange policy and the relatively high levels of debt in China and some other EMEs [emerging market economies] represented appreciable risks to global financial stability and economic performance". In order to investigate this issue I look at the dynamic effect of a negative technological shock to China's productivity and its transmission to the United States using Ghironi & Melitz (2005)'s DSGE model.

Regarding the trade policy, policy makers (mostly those in the Republican Party) have been pushing to replace America's current tax on corporate profits with a system that raises the costs of imports while helping exports by adding a tax on imports and a subsidy on exports. Companies currently deduct practically all of their costs, including imports, from their sales revenue and then pay taxes on the remaining profits. This new policy, known as a border-adjustment tax, essentially involves ending the deductibility of imports so that they would be taxed on their worldwide income. At the same time, profits on exports would no longer be taxed, and the overall tax rate would be cut. Many countries, but not the United States already have a form of national sales tax on imports and exports are exempt from value-added taxes. Currently China's average tariffs are about three times as high as those in the United States (New York Times, 2017). Lower American trade barriers have helped China to increase exports to the United States, while importing fairly little from the U.S.. In order to investigate this issue I look at the effect of a positive shock in U.S. trade costs (subsidy) and a negative shock in China's trade costs (tariff) to both the United States and China using Ghironi & Melitz (2005) DSGE model.

3. The model

3.1. Summary of the model and the equilibrium conditions

Once again, the model used in this paper is a stochastic, general equilibrium, two-country model of trade and macroeconomic dynamics developed by Ghironi & Melitz (2005). DSGE models have a simple structure, built around three interrelated blocks: a demand block, a supply block, and a monetary policy equation. A key advantage of DSGE models is that they share core assumptions on the behavior of households and firms, which makes them easily accessible to modify details that are relevant to address the question at hand. The equations that define these blocks derive from microfoundations and explicit assumptions about the behavior of the main economic actors in the economy (namely households, firms, and the government). These agents interact in markets that clear every period, which leads to the "general equilibrium" feature of the models.

The Ghironi & Melitz (2005) model has the advantage of inclusion international trade patterns into the standard DSGE model. Their model has the following interesting features: productivity differs across individual; there are monopolistically competitive firms in each country; firms face a sunk entry cost in the domestic market, both fixed, and per-unit export costs; only relatively more productive firms export (the export cutoff defines the level of productivity); firms face some initial uncertainty concerning their future productivity when making an irreversible investment to enter the domestic market. Furthermore, in their model exogenous shocks (such as aggregate productivity shocks, changes in domestic market regulation, and changes in trade policy) alter the composition of consumption baskets across countries over time by pushing firms into and out of the market. Differently from the other models, Ghironi & Melitz's (2005) model generates endogenously persistent deviations from the production possibility frontier that would not exist absent with heterogeneous firms. Also their model predicts that more productive economies, or less regulated ones, exhibit higher average prices relative to their trading partners. This real exchange rate appreciation is driven by entry and endogenous non-tradedness, the two key new features of Ghironi & Melitz's (2005) model setup. [27]

Table 16 in the Appendix reports the equilibrium conditions of Ghironi & Melitz (2005) DSGE model. The variables that strictly correspond to the home country (the United States) do not have an asterisk on top. The variables that strictly correspond to foreign country (China) do have an asterisk on top. Table 1 summarizes the nineteen endogenous variables of the model: w_t (real wage in the home country), w_t^*(real wage in the foreign country), $\tilde{d}_t$ (the average firm profit of home producers' domestic sales), $\tilde{d}_t^*$(the average firm profit of foreign producers' domestic sales), $N_{E,t}$(the number of firms entering the home market), $N_{E,t}^*$(the number firm entering the foreign market), $\tilde{z}_{X,t}$(export cut off in the home country), $\tilde{z}_{X,t}^*$ (export cut off in the foreign country), $N_{D,t}$(the number of domestic firms selling only in the home country), $N_{D,t}^*$(the number of domestic firms selling only in the foreign country), $N_{X,t}$ (the number of exporter firms in the home country), $N_{X,t}^*$(the number of exporter firms in the foreign country), r_t (the risk-free interest rate in the home country), r_t^* (the risk-free interest rate in the foreign country), $\tilde{v}_t$ (the entry cost in the home country), $\tilde{v}_t^*$ (the entry cost in the foreign country), C_t (the household consumption in the home country), C_t^*(the household consumption in the foreign country), Q_t (the exchange rate between the two countries, from the perspective of the home country). Additionally the model includes eight exogenous variables: the aggregate productivities Z_t and Z_t^*, and several policy variables, $f_{E,t}$(sunkentry cost in the home country), $f_{E,t}^*$ (sunk entry cost in

[27] For more details on the structure of the DSGE model please see Ghironi & Melitz (2005).

the foreign country), $f_{X,t}$(fixed trade costs in the home country), $f_{X,t}^{*}$ (fixed trade costs in the foreign country), τ_t(trade cost in the home country/iceberg cost), τ_t^{*}(trade cost in the foreign country/ iceberg cost). Changes in $f_{E,t}$, $f_{E,t}^{*}$ can be interpreted as changes in market regulation facing a country's firms in the respective domestic markets. Changes in $f_{X,t}$, $f_{X,t}^{*}$, τ_t and τ_t^{*} represent changes in trade policy.

3.2. Calibration

In the following section, I summarize the calibration used in this paper. I adopt the same calibration as Ghironi & Melitz (2005) since they were able to match numerous moments of the United States and international business cycle. In thus paper, differently from Ghironi & Melitz's (2005), China's trade iceberg costs are larger then (and not equal to) the United States once in order to reflect the current trade patterns between China and the United Sates (China has higher trade costs).

The discount factor, β, is 0.99 for the both countries, while the intertemporal elasticity of substitution is γ is equal to 2.[28] Periods are interpreted as quarters. The exogenous exit shock, δ is 0.25 to match the U.S. empirical level of 10 percent job destruction per year. The elasticity of substitution across goods (θ) is 3.8 in order to fit the U.S. plant and macro trade data from Bernard, Eaton, Jensen & Kortum (2003). The choice of θ = 3.8 then implies k = 3.4 (this satisfies the requirement k>θ −1). Export firms in the United States have a trade iceberg cost[29] (τ) of 1.5 to reflect the trade cost difference reported in the new York Times's article titles

[28] Both standard chooses for business cycle models.

[29] Iceberg trade costs mean that for each good that is exported a certain fraction melts away during the trading process as if an iceberg were shipped across the ocean. The model yields a simple micro-founded gravity equation from which the implied international trade costs can be inferred. This indirect approach results in a comprehensive measure of trade barriers that is both intuitive and easy to compute. For each good shipped, 1/(1 + τ) goods arrive at destination. The iceberg costs is an exogenous cost to transportation that diminishes over time. Variation in pricing across export markets is determined entirely by iceberg trade cost factor.

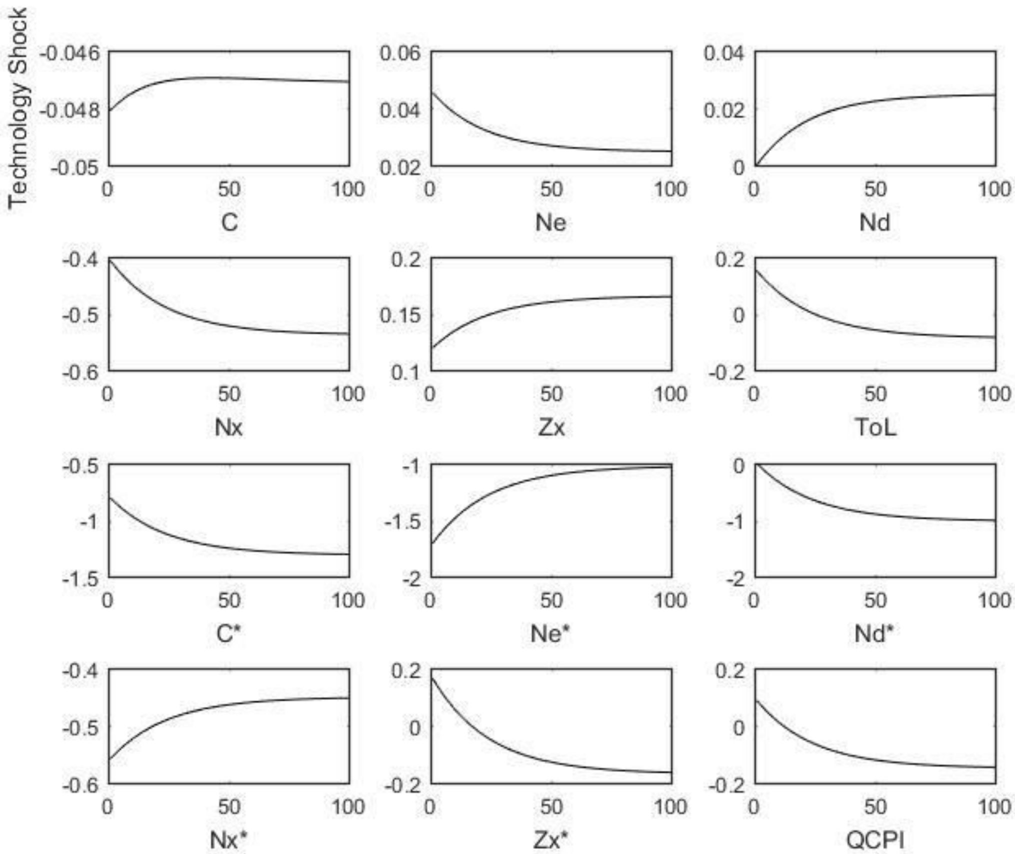
“Building Trade barriers” (New York Times, 2017). In the United States, fixed trade costs (f_x) equals 23.5 percent of the pre-period to match the proportion of exporting plants of 21 percent as reported by Bernard, Eaton, Jensen & Kortum (2003). China’s trade iceberg cost (τ^*) is set to be 1.3. The sunk cost in both countries, (f_E) is set to one. The calibration implies that on average, exporters in the U.S. are 65.4 percent more productive than importers. The steady-state share of expenditure on nontraded domestic goods is 0.78.

3.3. Impulse responses

Figure I shows the impulse responses (percent deviations from steady state) to a permanent 1 percent decrease in China’s productivity while Figure II shows the impulse responses to a permanent 20 percent decrease in the trade iceberg costs of the United States and a permanent 20 percent increase in trade iceberg costs for China. The number of quarters after the shock is on the horizontal axis.

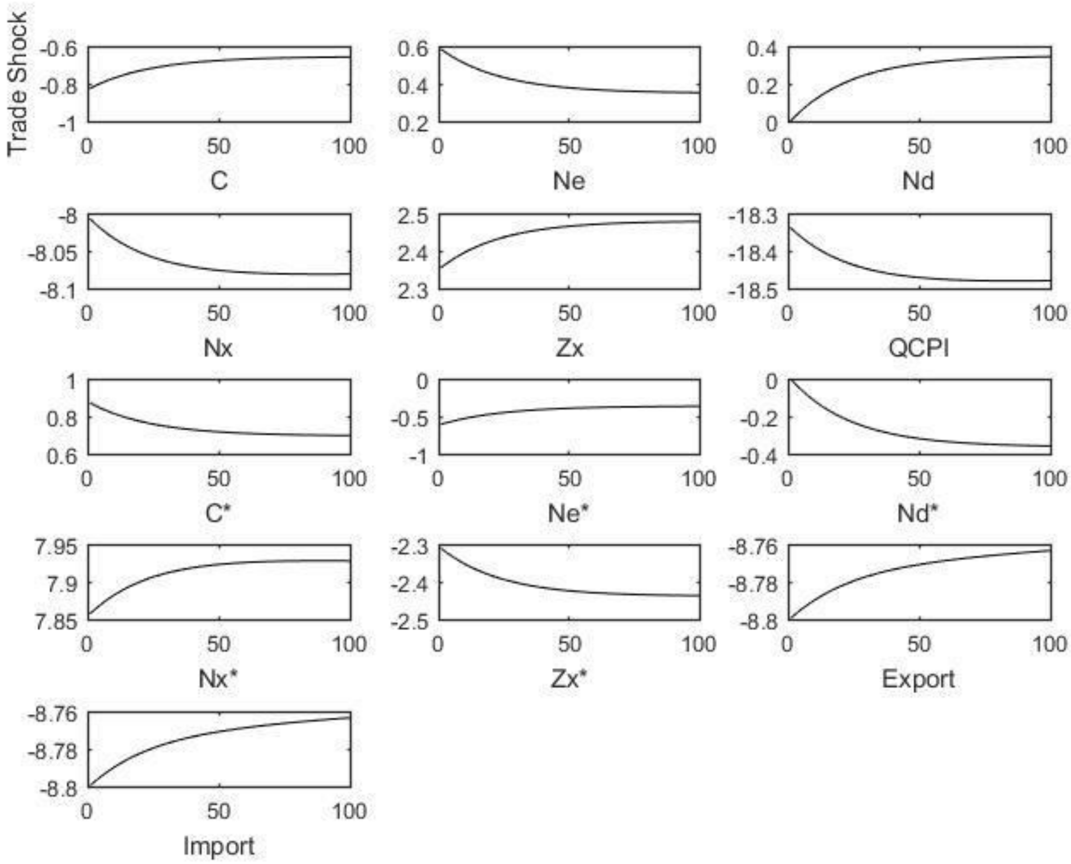
In Figure I, a negative technology shock in China results in a less attractive domestic market for Chinese producers. Consequently, the number of new American firms entering the United States increases while the number of new Chinese firms entering in China decreases. This translates into a permanently higher number of producers in the United States and in contrast a permanently lower number of producers in China. In other words, the number of new entrant firms (Ne) represents the United States consumer investments, which increases at first, adding firms to the stock of already producing firms (Nd). In China, the immediate impact of the productivity shock reduces the supply of Chinese effective labor units relative to foreign. The labor shortage bids up the price of Chinese labor in the United States in the short run, which increases the Chinese export cutoff (zx*). The US export cutoff also increases due to a temporary decline in foreign demand. Therefore, both countries experience a reduction in the number of exporters (Ne, Ne*). After the initial shock to China's productivity, the number of new entrant firms continues to decrease, reversing the effect of the initial appreciation of labor in the United States. Because enjoy less variety of consumption goods. As expected, the dollar depreciates at first because of an increase in the prices of Chinese goods (decrease in supply). However, in the long run the exchange rate appreciates as a result of US increasingly substituting away Chinese made goods.

Figure 3: Response to a Permanent Negative shock on China's Productivity (Z)



Note: C is consumption in the United States. C* is consumption in China. Ne is the number of entry firms in the United States. Ne* is the number of entry firms in China. Nd is the number of total firms in the United States. Nd* is the number of total firms in China. Nx is the number of exporting firms in the United States. Nx* is the number of exporting firms in China. Zx is the export cut off level in the United States. Zx* is the export cut off level in the China. ToL is the effectiveness of the labor market in the United States compared to China's workers. QCPI is the exchange rate (dollars/Yean).

Figure 4: Response to a Permanent Shock on both China and the United States' iceberg cost of trade (τ, τ*) on both economies



Note: C is consumption in the United States. C* is consumption in China. Ne is the number of entry firms in the United States. Ne* is the number of entry firms in China. Nd is the number of total firms in the United States. Nd* is the number of total firms in China. Nx is the number of exporting firms in the United States. Nx* is the number of exporting firms in China. Zx is the export cut off level in the United States. Zx* is the export cut off level in the China. ToL is the effectiveness of the labor market in the United States compared to China and also an approximation of the exchange rate. QCPI is the exchange rate (dollars/Yean). Export is U.S. exports. Imports is U.S. Imports.

Figure II looks at the effect of a subsidy on US exports while simultaneously imposing a tariff on its imports. First, a tariff on Chinese goods causes Chinese prices to decline in order to compete with American products. Less firms will enter China's market (Ne*), which permanently reduces the number of overall firms (Nd*). On the contrary, U.S. prices will increase causing the dollar to appreciate. Most of the appreciation of the U.S. dollar is driven by a reduction of Chinese prices and an increase in the prices of American goods, causing the exchange rate to decrease.30 This results in a permanent depreciation of China's labor that leads to a decrease in the home export cutoff, allowing a larger number of Chinese firms to export. The dollar appreciation decrease in the number of exporting firms in the United States and a corresponding increase in the number of exporting firms in China. The opposite happens in the United States so that American firms need to be more productive than they were before the shock in order to able to export. As a result, American consumers are worse off since there is less variety (due to comparative advantage). Because of this new trade policy, both total imports and exports in the United States decrease by approximately 8 percent (please note that if the permanent trade shocks were to be smaller, the decrease in imports and exports would have been lower as well).

4. Conclusions

This paper uses a stochastic general equilibrium model previously introduced by Ghironi & Melitz (2005) to investigate a relevant international issue and an upcoming United States' trade policy (namely, China economic slowdown and the United States' proposed Border Adjustment Tax).

In the first case, China is strongly affected by a permanent shock on its productivity.

[30] Please note that the real exchange rate is calculated as the following: $Q_t = \varepsilon_t P_t^* / P_t$. Here ε_t is the nominal exchange rate, P_t^* is the price of Chinese goods at time t, P_t and is the price of U.S. goods at time t.

American firms enter into the United States market to offset the reduction in exports of Chinese products, which decreases consumption (resources are not efficiently allocated). American consumers are worst off as the variety of goods available decreases.

In the second case, a tariff on imports and a subsidy on exports leave consumers in the United Sates (China) slightly worst (better) off after the trade policy is implemented. The labor market in China is damaged by this new trade policy. Simultaneously, fewer firms enter the Chinese market, which leads to an increase in consumer prices in the United States.

To conclude, a reduction in China's productivity has a positive effect on American firms and labor while it has a negative effect on exports and consumption. Overall investors and policy makers should not fear a possible contraction in China's economic growth. Finally, a Border Adjustment Tax of 20 percent increase the U.S. dollar of approximately 20 percent (relative to the world basket of currencies) which would fully offset the tax paid by importers and the subsidy received by exporters. This policy is fully worthy of consideration, but also suffers from several implementation risks (such as higher prices of goods for American consumers and less verity).

Conclusions

In the first chapter I conclude that the resulting CIT-rate differentials among countries is leading to BEPS as MNEs shift profits from affiliates located in high CIT-rate countries to affiliates located in low CIT rate countries to minimize their aggregate tax liabilities thus increasing their worldwide after-tax profits. This chapter seeks to gauge the effect of CIT-rate differentials among countries on BEPS. I improve upon the existing literature by accounting for whether countries actually enforce their transfer-pricing rules and when they have the incentive to do so because of the tax incentive facing domestic affiliates of MNEs. I report strong evidence that correctly specifying the model of reported profits in the manner prescribed in this paper has important implications for the correct choice of function form and a substantial effect on the estimated semi-elasticities of reported profits. The main results are the following: the estimated semi-elasticity of BEPS is equal to -3.5, meaning that a 10% increase in the tax rate differential between countries results in a 35% decrease in reported earnings in the high tax country; when there is an increase in the incentive for outbound profit shifting, firms that are located in countries with strict anti-avoidance rules report 32% more profits than otherwise; when there is an increase in the incentive for inbound profit shifting, firms with ultimate owners located in countries with strict anti-avoidance rules report 10% less profits than otherwise. I also conduct a policy simulation to illustrate the practical importance to tax policy analysis. I use my preferred estimates of the semi-elasticities of reported profits as well as an estimate of this semi-elasticity using a state-of-the-art but misspecified model to conduct the policy simulation. This exercise shows that using estimates of the semi-elasticities from a correctly specified model (that takes into account enforcement) has a substantial effect on the estimated tax revenue effect of the proposed reform. Future reaserch should apply the same methodology used in this paper for developing coutries for which very little has been done.

In the second chapter of my dissertation, I compute a principle component analysis using federal funds futures and the LIBOR to capture short and long-run financial markets' monetary policy expectations in the United States. Differently from the current literature I use data on federal funds futures and eurodollar futures collected not only on days of FOMC meeting but also on days when other macroeconomic indicators are announced (namely change in non-farm payroll, initial job claims, GDP, ISM, CPI, consumer confidence index, University of Michigan consumer sentiment index, retails sales and new home sales). These macroeconomic indicators are selected based on their Bloomberg relevance index, which identify investors most followed announcements on Bloomberg. After computing an event study I make three important contributions to the current literature: first, monetary policy expectations are affected by unexpected values of non-farm payroll, initial job claims, GDP, ISM, CPI, consumer confidence index, University of Michigan consumer sentiment index, retails sales and new home sale; second, interest rates are expected to rise (fall) as a consequence of positive (negative) macroeconomic indicators and FOMC announcements; third, financial markets not only react to changes of short- and long-term monetary policy expectations on days of FOMC meetings, but also on days when other macroeconomic news are publically announced. As previously discussed, these results suggest that investors adjust their monetary policy expectations based on the state of the economy and that financial markets are vulnerable to surprises in macroeconomic news as well as FOMC announcements. These results emphasize the importance of a transparent and well thought communication between the Federal Reserve and financial investors in order to promote stability and stimulate investments. Future reaserch should extend the methodology used in this paper to minutes data on stock markets.

In the last chapter, I use a stochastic general equilibrium model previously introduced by

Ghironi & Melitz (2005) to investigate a relevant international issue and an upcoming United States' trade policy (namely, China economic slowdown and the United States' proposed Border Adjustment Tax). In the first case, China is strongly affected by a permanent shock on its productivity. American firms enter into the United States market to offset the reduction in exports of Chinese products, which decreases consumption (resources are not efficiently allocated). American consumers are worst off as the variety of goods available decreases. In the second case, a tariff on imports and a subsidy on exports leave consumers in the United Sates (China) slightly worst (better) off after the trade policy is implemented. The labor market in China is damaged by this new trade policy. Simultaneously, fewer firms enter the Chinese market, which leads to an increase in consumer prices in the United States. To conclude, a reduction in China's productivity has a positive effect on American firms and labor while it has a negative effect on exports and consumption. Overall investors and policy makers should not fear a possible contraction in China's economic growth. Finally, a Border Adjustment Tax of 20 percent increase the U.S. dollar of approximately 20 percent (relative to the world basket of currencies) which would fully offset the tax paid by importers and the subsidy received by exporters. This policy is fully worthy of consideration, but also suffers from several implementation risks (such as higher prices of goods for American consumers and less verity). Future research should calibrate the DSGE model used in this paper to better represent China and the United States economic relationship (in this paper I used the standard calibration).

Appendix

Table 16: Model Summary

Endogenous variables	Equilibrium Equation
Price Indexes	$N_{D,t}\left(\tilde{\rho}_{D,t}\right)^{1-\theta}+N_{X,t}\left(\tilde{\rho}^{*}_{X,t}\right)^{1-\theta}=1$
	$N^{*}_{D,t}\left(\tilde{\rho}_{D,t}\right)^{1-\theta}+N^{*}_{X,t}\left(\tilde{\rho}^{*}_{X,t}\right)^{1-\theta}=1$
Profits	$\tilde{d}_t=\tilde{d}^{*}_{D,t}+\frac{N^{*}_{X,t}}{N^{*}_{D,t}}\tilde{d}^{*}_{X,t}$
	$\tilde{d}^{*}_t=\tilde{d}^{*}_{D,t}+\frac{N^{*}_{X,t}}{N^{*}_{D,t}}\tilde{d}^{*}_{X,t}$
Free entry	$\tilde{v}_t=w_t\frac{f_{E,t}}{Z_t}$
	$\tilde{v}^{*}_t=w^{*}_t\frac{f^{*}_{E,t}}{Z_t}$
Zero-profit export cutoffs	$\tilde{d}_{X,t}=w_t\frac{f_{X,t}}{Z_t}\frac{\theta-1}{k-(\theta-1)}$
	$\tilde{d}^{*}_{X,t}=w^{*}_t\frac{f^{*}_{X,t}}{Z^{*}_t}\frac{\theta-1}{k-(\theta-1)}$
Share of exporting firms	$\frac{N_{x,t}}{N_{D,t}}=(z_{min})^{k}\left(\tilde{z}_{X,t}\right)^{-k}\left[\frac{k}{k-(\theta-1)}\right]^{k/(\theta-1)}$
	$\frac{N^{*}_{x,t}}{N^{*}_{D,t}}=(z_{min})^{k}\left(\tilde{z}^{*}_{X,t}\right)^{-k}\left[\frac{k}{k-(\theta-1)}\right]^{k/(\theta-1)}$
Number of firms	$N_{D,t}=(1-\delta)\left(N_{D,t-1}+N_{E,t-1}\right)$
	$N^{*}_{D,t}=(1-\delta)\left(N^{*}_{D,t-1}+N^{*}_{E,t-1}\right)$
Euler equation (bonds)	$\left(C_t\right)^{-\gamma}=\beta(1+r_{t+1})E_t[(C_{t+1})^{-\gamma}]$
	$(C^{*}_t)^{-\gamma}=\beta(1+r^{*}_{t+1})E_t[(C^{*}_{t+1})^{-\gamma}]$

Euler Equation (shares)	$\tilde{v}_t = \beta(1-\delta)E_t\left[\left(\frac{C_{t+1}}{C_t}\right)^{-\gamma}\left(\left(\tilde{v}_{t+1}+\tilde{d}_{t+1}\right)\right)\right]$
	$\tilde{v}_t^* = \beta(1-\delta)E_t\left[\left(\frac{C_{t+1}^*}{C_t}\right)^{-\gamma}\left(\tilde{v}_{t+1}^*+\tilde{d}_{t+1}^*\right)\right]$
Aggregate Accounting	$C_t = w_t L + N_{D,t}\tilde{d}_t - N_{E,t}v_t$
	$C_t^* = w_t L + N_{D,t}\tilde{d}_t - N_{E,t}v_t$
Balanced Trade	$Q_t N_{X,t}\left(\tilde{\rho}_{X,t}\right)^{1-\theta} C_t^* = N_{X,t}^*\left(\tilde{\rho}_{N,t}^*\right)^{1-\theta} C_t$

Source: Ghironi &Melize (2005). For the explanation of the parameters please see the text or Ghironi &Melize (2005)'s paper.

Table 17: The Effect of monetary policy expectations on financial markets on days of macroeconomic indicators announcements

Days	S&P500		VIX		Three-months Treasury Note		One-year Treasury Bill		Ten-years Treasury Bond	
	Path	Target	Path	Target	Path	Target	Path	Target	Path	Target
Change In Non-Farm Payroll	0.010***	-0.059*	-1.328***	2.852	0.052***	0.726***	0.169***	0.619***	0.284***	-0.278***
Initial Job Claims	0.019***	0.018	-2.102***	-6.327	0.059***	0.882***	0.193***	0.703***	0.336***	-0.076
GDP	0.009	-0.097*	-1.500	17.077*	0.014	0.686**	0.141***	0.531***	0.350***	-0.334**
ISM	0.036***	0.013	-4.537***	-1.570	0.072***	0.122***	0.198***	0.141***	0.349***	0.241***
CPI	0.007	-0.047	-1.813*	5.824***	0.041	0.988**	0.152***	0.659**	0.336***	-.164*
C.C.I. **	0.035***	-0.055	-5.030***	13.384	0.050***	0.241	0.155***	0.512***	0.370***	-0.334***
U. Michigan Consumer Sentiment Index	0.018***	0.026	-1.831*	-8.499*	0.060**	0.374	0.200***	0.410**	0.350***	0.012
Retails Sales	0.019*	0.102	-1.954*	-16.520*	0.056***	1.133***	0.161***	0.881***	0.332***	-1.000***
New Home Sales	0.013	0.019	-1.784*	1.146	0.100***	0.162	0.172***	1.092***	0.349***	-0.418*
FOMC	0.018**	-0.011	-2.202*	-3.962	-0.014	0.680***	0.166***	0.531***	0.333***	-0.103**

Note: Newey-West (1987) Heteroskedasticity and Autocorrelation Constant Standard errors in parenthesis (HAC, 3 lags). Results expressed in percentage for the S&P500 and VIX and in basis points for treasury bill and notes. The path factor represents long-term monetary policy expectations; the target factor represents short-term monetary policy expectations. ** Consumer Confidence Index

Table 18: The Effect of monetary policy expectations on financial markets on days of macroeconomic news announcements during the latest global financial crisis

Days	S&P500		VIX		Three-months Treasury Note		One-year Treasury Bill		Ten-years Treasury Bond	
	Path	Target	Path	Target	Path	Target	Path	Target	Path	Target
Change In Non-Farm Payroll	0.016*	-0.023	-1.599**	6.613	0.037***	0.504	0.112***	0.217	0.272***	-0.218
Initial Job Claims	0.023*	0.088	-2.443**	-12.687	0.040**	0.916	0.157***	0.699***	0.352***	-0.295
GDP	0.010	-0.148**	-0.683	27.263**	-0.014	0.459	0.081***	0.475***	0.398***	-0.337**
ISM	0.071***	0.013	-6.476***	2.301	0.028	0.123	0.136***	0.116*	0.418***	0.301***
CPI	0.023	-0.239**	-2.901*	25.000**	-0.015	0.122	0.096***	0.260	0.399***	-0.537**
C.C.I. **	0.054***	-0.174	-7.99***	26.809	0.018	-0.007	0.112***	0.501***	0.416***	-0.710***
U. Michigan Consumer Sentiment Index	0.036***	0.091	-3.692**	-35.932***	0.005	0.875*	0.156***	1.047	0.366***	-0.426**
Retails Sales	0.026*	0.053	-3.554	-8.953*	0.051	1.111*	0.162***	0.865**	0.314***	-2.510***
New Home Sales	0.002	-0.130	-1.262	7.729	0.033	-0.142	0.109***	0.500	0.375***	-1.200*
FOMC	0.029**	0.032	-3.202	-13.418***	.033	0.651***	0.132***	0.668***	0.362***	-0.258*

Note: Note: Newey-West (1987) Heteroskedasticity and Autocorrelation Constant Standard errors in parenthesis (HAC, 3 lags). Results expressed in percentage for the S&P500 and VIX and in basis points for treasury bill and notes. The path factor represents long-term monetary policy expectations; the target factor represents short-term monetary policy expectations. The event window is from December 2007 to June 2010.
** Consumer Confidence Index.

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VITA

Giulia Zilio was born August 9, 1988 in Venice, Italy. She has a B.A. and a Master degree with Summa Cum Laude in Economics from Ca Foscari University of Venice, Italy. In 2010, Giulia traveled to the United States to pursue her Master and Ph.D. degrees in Economics at the Andrew Young School of Policy Studies, Georgia State University. She finished her Master degree in 2012 and the Ph.D. degree in 2017.

Her professional philosophy as an economist is that empirical research should be driven by real-world questions and investigated with rigorous economic theory. Her general research interests lie in the area of macroeconomics – including financial economics, international trade and growth. As a result, she considers herself an applied macroeconomist with broad theoretical and empirical interests.

During the last two years of her Ph.D. degree she had the great opportunity to work for the Federal Reserve Bank of Atlanta in Atlanta, United States. Here, she wrote a set of articles for the online Federal Reserve Magazine ("Economy Matters") in 2016 which look at the effect of China's economic slowdown worldwide from a trade perspective: "Trade Dynamics between the United States and China: Part 1", "Trade Dynamics between the World and China: Part 2", and "Comparing the United States and China, a Trade Analysis: Part 3".

She have a demonstrated record of success as a researcher for the Fiscal Research Center of Georgia State University where she wrote reports on the condition of the labor market in Georgia and the United States. Furthermore, during the first two years of her Ph.D. degree she worked at the Economic Forecasting Center, where she helped develop forecasting models that contributed to national forecast surveys including the Federal Reserve Bank of Philadelphia, Blue Chip Indicators and USA Today. She has two years of experience as a researcher for a branch of the United Nations in Atlanta (namely CIFAL Atlanta). Finally, as a graduate teaching assistant at Georgia State University, she taught multiple sections of Principles of Macroeconomics and Principles of Microeconomics as a supplemental instructor.

Giulia has received several awards from the Andrew Young School of Policy Studies. In particular, she received the Undergraduate Academic Research Excellence Award in 2012 and the Leadership Award in 2014 from the Andrew Young School of Policy Studies.